Theoretical Framework for Determinants of A/E/C Firm Value, Strategy and Continuity: An Analysis Incorporating Corporeal, Volitional and Knowledge Assets

A Thesis
Presented to
The Academic Faculty

By

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In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy in the
College of Architecture

Georgia Institute of Technology
May 2011

THEORETICAL FRAMEWORK FOR DETERMINANTS OF A/E/C FIRM VALUE, STRATEGY AND CONTINUITY: AN ANALYSIS INCORPORATING CORPOREAL, VOLITIONAL AND KNOWLEDGE ASSETS

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ACKNOWLEDGEMENTS

During our business and academic careers, we are sometimes fortunate to stand on the shoulders of giants. My work at the American Society of Civil Engineers in the early 1990s was propelled by Preston Haskell, Chairman of The Haskell Company, Jacksonville, FL, who significantly expanded the dissemination of my report of the deliberations of ASCE's Design-Build Task Force, and who later founded the Design-Build Institute of America (DBIA) where I served for a decade as chief executive.

At DBIA's first Professional Design-Build Conference in Atlanta in 1994, I had the distinct pleasure of working with Prof. Saeid Sadri of the Georgia Institute of Technology. Our collaboration and friendship led to a Teaching Assistantship position within the College of Architecture as an instructor for graduate-level project delivery and project management courses. For those marvelous experiences at Georgia Tech from 2000 to 2005 and for his ongoing encouragement of my scholarly work, I am eternally grateful to this internationally capable and beloved mentor.

Upon my matriculation within the College of Architecture, I was inspired by engineer and professor Godfried Augenbroe, who challenged me to justify my practical notions about the A/E/C industry with sufficient empirical observation and experiment. Socratic questioning by Prof. Augenbroe provided the window to this thesis topic, with its focus on the business of design and construction. The support and sagacity of Prof. Augenbroe has provided sustenance to a generation of aspiring scholars, and we regard him as the "Oracle of Optimization." He has helped graduate students across the globe in the myriad small ways -- conversations over a glass of Bordeaux or fine Dutch beer with fellow graduate students would at first lend themselves to fond reminiscences, but we have no doubt these stories will later turn into pedagogical mythology.

The completion of this research project would not have been possible without the 21 expert panelists who participated in my Delphi rounds. While I cannot name these nationally-known design and construction professionals due to confidentiality issues, I am indebted to these individuals for their insights and forbearance during six months of questionnaires, feedback and responses. I regard each of them as contemporary giants in the fields of architecture, engineering and construction in the United States.

A constant in my life has been the love and companionship of my wife June, who forfeited some of her dreams to help her husband and daughters to follow theirs. The accomplishments of my academic and vocational pursuits, including this thesis, were made possible only through her beneficence and wisdom.

"What wisdom can you find that is greater than kindness?"

__ Jean-Jacques Rousseau in *Emile*, 1762

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SUMMARY

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Theoretical Framework for Determinants of A/E/C Firm Value, Strategy and Continuity: An Analysis Incorporating Corporeal, Volitional and Knowledge Assets

Classical economists, students of production theory and input-output researchers have focused on linear processes of extraction and manufacturing industries, and have mostly ignored the iterative problem-solving and network exchange processes of firms in the modern services sector. Through an examination of the production logic of architectural, engineering and construction (A/E/C) firms, contemporary research can begin to sort out a firm's value configuration by statistically analyzing their method of transforming capital assets to outputs. There is little empirical evidence pointing to what factor inputs are emphasized by these A/E/C firms given their production logic. Because output differences among A/E/C firms are often stark, research into value configuration and capital asset deployment by these firms may shed new light on patterns of tangible and intangible asset accumulation and exploitation.

The objective of the research is to ascertain the fundamental differences in value configuration and production logic of architectural, engineering and construction firms; and then to determine what asset group categories are combined by various categories of firms when the managerial goal is either continuity and longevity of the company or, alternatively, short-term profit maximization. A specific research goal is to frame a methodology that can be used to categorize firm value configurations (production logics) and to determine what asset group classes (physical and financial capital assets as well as organizational, competence and motivational assets) are deployed by different classes of A/E/C firms.

Given the need to understand both the relationships among these two distinct aspects of firm operations and in light of the goal of exploring different patterns of A/E/C firm production logic and asset deployment, a mixed methods research approach was undertaken to achieve the result. In the first phase, a third party survey was identified, permission obtained for its use, and portions of its raw data were extracted and re-analyzed, in an attempt to find asset pairs that affected firm longevity or profit maximization. In the second phase, a Delphi expert panel was assembled and provided answers to a customized survey questionnaire in three separate rounds, in an effort to build consensus toward common results. The expert panel was engaged to further explore, refine and test the proposed combinatorial (tangible and intangible assets) model. By employing good Delphi protocol (i.e., independent judgment, anonymity and feedback to experts after each round), the level of agreement as measured by Kendall's W (coefficient of agreement) was generally excellent.

The overall structure of the research theme consists of two vital components. First, a "*Production Logic Framework*" component is adopted from the Stabell-Fjeldstad (1998) model and services as the theoretical lens for A/E/C samples firms listed in the study. The Production Logic Framework has been tested, verified and confirmed by a series of researchers, including, among numerous other references and citations, Amit and Zott (2000), Gottschalk and Solli-Saether (2001) and Tallon et al (2007). Second, a component that has the appearance of a "periodic chart" of tangible and intangible assets was developed for this research, and was subsequently validated by the 21 person expert panel (19 of the 21 verified the logic and content of the model and 2 suggested very minor adjustments). The organizational "*Total Asset Model*" of the firm is described and decomposed in various chapters of this thesis, and serves as a basis for expert panel assessment of asset category emphases by differing classes of A/E/C firms.

Research outcomes include a series of three dozen "radar" charts showing asset emphases by differing firm classifications, from which patterns of tangible versus intangible asset accumulation and deployment emerge. Among the results determined by the study are: 1) traditional construction entities such as road construction firms emphasize physical and financial (tangible) asset groups in the conduct of their business; and 2) for A/E enterprises; architectural design firms emphasize competence and motivation (intangible) assets; and engineering firms emphasize competence and organizational (intangible) assets in the conduct of their businesses. For firms that concentrate on functioning as both the A/E-of-record and the constructor-of-record, including the design-build and EPC firms in the study, competence and organizational (intangible) assets were deemed as more important among the seven asset categories identified in the model (physical natural, physical produced and financial tangible assets; legal and registrable assets, which may be allocated as either tangible or intangible assets, depending on the circumstances; and organizational, competence and motivational [including leadership] assets, which are designated within the meta-category of intangible assets).

Among the benefits of the research are the solidification of a framework within which both tangible and intangible assets (or as more appropriately labeled, corporeal and volitional assets) may be conceptualized and measured for purposes of ongoing and future investigations, and a methodology for benchmarking ongoing investments in a firm's portfolio of resources. Secondary benefits of the research include the proffering of an employee survey that can be used to formulate a firm statement of activities relating to intangible assets (that is, those activities that would not be shown on the firm's financial income statement), as well as templates for asset inventory summary sheets (with a tabulation column for depreciation) and a culminating template for assemblage of firm-based non-financial reports, including an intangible assets balance sheet. These latter templates are postulates and have not yet been tested. However, they represent fertile ground for future research.

"*Ideas are capital, the rest is just money*." __ from a Deutsche Bank brochure in 2001

CHAPTER 1 INTRODUCTION AND OVERVIEW

1.1 Executive Summary and Introduction

When a question arises about use of capital – that is, about assets to be deployed in production processes – managers focus and accountants fret. No issue gives economists more trouble, whether they are Marxian or Keynesian, because of Schumpeterian uncertainty, partial information, imperfect competition and the emergence of intangible capital assets (Hulten 2004). Despite practical evidence of their severe limitations as a strategic management tool, modern financial accounting practices only count and record traditional physical and financial assets, following practices that were established in mercantile Italy during the Renaissance and later widely adopted by larger enterprises during the Industrial Revolution. Modern accounting still barely acknowledges intangible and knowledge assets, except through occasional footnotes on the balance sheet. But an important feature of modern economies in the 21st century seems clear, according to the NYU's Baruch Lev: intangible factors are playing an increasingly dominant role in wealth creation. Corporate profitability is often driven more by organizational capabilities than by control over physical resources (Lev 2001).

Resource-based theory relies on the assumption that firms gravitate toward growth by utilizing all of the firm's available resources, including physical, financial, organizational and intellectual (Anantadjaya 2008). Management recognizes that there are productive and unproductive assets within the firm, and part of their charge is to mobilize unproductive or under-performing resources that are controlled or influenced in the firm's production process. This research project attempts to provide a bridge between resource-based theory, which is somewhat progressive in acknowledging the presence of both tangible and intangible assets, and production theory, which has been based on a rather regressive view of input – output analysis (how the firm can make its output more efficient by varying the input mix among traditional land, labor and capital factors).

Classical production theory does not recognize that the output of services (such as architectural and engineering services) must include processes where services are produced and delivered under constraints that are not encountered with output of goods. Goods can be consumed or used long after they are produced, in places that are far from the location of the production of their components. Services cannot be produced without the agreement, cooperation and in many instances, active participation of the consuming entities. Services are not inventoried: one would not maintain a storehouse of appendectomies at the hospital nor a hangar full of passenger miles at the airport (Hill 1997). The nature of service outputs and the distinctive production processes of service establishments (such as when compared to manufacturing industries) make a strong case for alternative theories of production. Further, the nature of production processes in the contemporary technological age suggests that perhaps emergent forms of enterprise use differing factor inputs than traditional extraction and manufacturing industries, and hence the capital asset mix consists of much more than the agrarian-based land, labor and capital inputs.

This research frames a methodology that can be used to categorize firm value configurations (production logics) and choices of factor inputs (tangible and intangible assets) to fuel production cycles. A secondary goal of this research project is to attempt to determine which asset group combinations may combine to produce sustainable outcomes for A/E/C firms. To achieve these goals, a "Production Logic Framework" is adopted from the Stabell-Fjeldstad model and this model serves as a theoretical lens for the A/E/C firms analyzed in the study; and a new organizational "Total Asset Model" is constructed and validated, which subsequently serves as a basis for expert panel assessment of asset emphases by various firms focused alternatively on success (profit maximization) or survival (continuity and longevity).

The chapter structure of this thesis reflects the chronological steps taken to fulfill the research agenda as outlined in the Table of Contents of this paper:

Chapter 1 – *Introduction and Overview*: This study provides an intersection between the operating strategies chosen by firms – and in particular A/E/C firms – with tangible and intangible factor inputs, which include physical, financial, organizational and knowledge assets. The study begins by collecting diverse types of data to provide a broad understanding of the research problem, and follows this initial work with a more detailed and focused look at specific aspects of the problem. The National Bureau of Economic Research recently issued a system of national accounts (acknowledging both tangible and intangible assets) that is designed to mesh with the national economy, but creators of this macro-economic schema lament the fact that a counterpart firm-level micro-economic system has not been formulated, particularly on an industry-by-industry basis (Jorgenson et al 2006). This study makes an effort to partially redress that void by investigating how such a system of accounts, measured on the input side of the ledger, could begin to fill in the blanks with necessary information needed for an industry-based micro-economic framework.

Chapter 2 – *Literature Review and Definitions*: Although research into intangible and knowledge assets began in earnest during the 1980s, the concepts of knowledge intensive and networked organizations are still at a very early stage of development. Therefore, it is important to examine existing literature in order to explore the evolution of value creation strategies and deployment of resources by firms, which in turn helps to identify the bases for these concepts and to uncover the most-accepted definitions. The literature survey casts a wide net, pulling in broad notions of the global forces of economic change, before narrowing its focus toward operating differences among industries, and then zeroing in on the nature of A/E design and construction within the context of operating strategy and factor inputs.

Chapter 3 – *Theoretical Background and Foundations for the Research*: By exploring the theoretical underpinnings and existing research that seek to explain the theory of the firm, one finds traditional industrial organization and accounting theory being challenged by resource-based and strategic management theory. After exploring the theories of the firm (including a nascent theory of sustainable firms), conceptual models based on interpretations of the most relevant theories to this research are proffered. The chapter's section on Industrial Organization (IO) theory acknowledges the claim by IO theory's proponents that firm performance is determined by organizational structure, while other factors are ignored (Galbreath 2004). Business and management scholars warn that when markets shift, new technologies are introduced and new competitors emerge, firms must consistently create new knowledge, diffuse it through their organizations and find ways to capitalize on the advantage (Hitt 1998). However, empirical research in the resource-based theoretical stream has also fallen short of identifying which classes of resources, as utilized in the pursuit of their market strategies, are determinants of firm success (Foss 1997).

Chapter 4 – *Tangible and Intangible Assets/Corporeal and Volitional Assets – National Systems, Industrial Sectors and Firms Specific Resources – Foundations and Definitions*: Firms will have a different and richer perspective on their growth prospects if they look at portfolios of resources, rather than products or markets (Wernerfelt 1984). It is this assertion by the prominent Sloan School (MIT) scholar that impels this researcher to devote a separate chapter to intangible and tangible resources. It is the idiosyncratic resources that firms control and deploy that are the sources of their competitive advantage (Galbreath 2004). Resource based theory has gained much prominence in the literature since the early 1990s as an alternative explanation to Industrial Organization theory as to why some firms perform better than others. But it would be premature to abandon tangible assets as factor inputs that do not influence firm performance (Foss 1997). Instead, a way should be found to blend intangible and tangible assets into an amalgam of factor inputs more closely representing actual firm practice. Unfortunately, some of the reluctance to embrace "intangible" is the limitation of the word itself: abstract, ethereal, insubstantial, fleeting, elusive and unable to be grasped mentally (Oxford 1996). Instead, this researcher proposes (and introduces gradually in this paper) a transition to the words "corporeal" and "volitional." Corporeal assets (in lieu of tangibles) would include the body of physical, financial and legally registrable assets that the firm controls or influences in the conduct of its business. Volitional assets would include the organizational, competence and motivation assets that can be measured, often through non-financial metrics, within the operations of the firm. Taken together, corporeal and volitional assets would represent components of the “body” and the “will” of the firm. These two constituents are further decomposed into specific asset groups and subgroups in the succeeding chapters.

Chapter 5 – *Current and Proposed Asset-Based Indicators of Firm Operations – Selected List of Resource-Based Factors and Proposed Conceptual Model*: To construct a conceptual model of asset deployment by firms, it is necessary to develop asset categories based on resources that are internal to the firm. To go beyond this limitation (internal assets) would lead one to a hopeless task (at least for purposes of a single dissertation) of an all-inclusive internal and external list of resources, many of which would be outside of the control or influence of an individual firm. This research seeks to formulate a pragmatic, rather than perfect, approach to identifying and analyzing a firm’s asset catalogue that can be conceptualized in light of production logic options available to classes of firms. Identification and modeling of a firm’s available asset catalogue is actually the first step in applying the research methodology for this inquiry, and this modeling leads to the construction of a new organizational “Total Assets Model.” A selected list of current and proposed methods for measuring a variety of individual tangible and intangible assets (i.e., corporeal and volitional assets) is included in this chapter.

Chapter 6 – *Methodology, Data Collection and Modeling*: As a result of the literature review and foundational research found in Chapters 2, 3 and 4, a system-wide view of A/E/C firm production logic can be constructed, which is a requisite step toward defining key concepts in relation to the overall system of asset deployment by firms in a national economy. A mixed methods approach is adopted for this research project. The justification for using mixed methods is based on a “bottom up/top down” two-phased sequential approach, which obtains statistical data from an industry sample in the first phase, and then asks a small group of industry experts from the same industry pool to participate in a short-form survey about asset categories, and then to validate and verify results from the latter survey. It is then the task of this researcher to analyze results of both phases and to interpret whether there are patterns or indications that, together or separately, support any of the hypotheses stated at the outset of the study. Given the specific focus of the research, only firms operating as A/E/C firms are included in the study. Of the firms responding to the study, 11 percent are primarily architecture firms focused on the buildings markets; 68 percent are primarily engineering firms, concentrating mostly on civil infrastructure projects; and 21 percent are devoted to construction, although many of these firms have A/E services in-house. A value logic model designed to show the production processes of three different types of firms, and an aggregation model of a firm's total available assets are depicted in this chapter, and these representations of propounded attributes of selected types of firms will be validated by industry experts.

Chapter 7 – *Quantitative Assumptions and Delimitations – Phase I*: With the quantitative approach, a researcher employs cause-and-effect thinking in order to condense expansive information into specific variables that can be tested according to hypotheses and research questions. In this instance, information is derived from a third party industry survey that has been placed into an instrument that yields statistical data. Variables are identified and related to the various hypotheses and questions to verify whether the theories comport with the quantitative results of the data analysis. Because part of the research problem involves identifying factors that may influence an outcome, the quantitative approach seems well-suited to looking at the relationship between factor input categories for targeted firms. Nevertheless, there are limits and constraints inherent in quantitative research, not all of which (in fact, somewhat less than one would hope) can be overcome in a single research project. Third-party survey data from a national non-profit engineering association is used for the Quantitative portion of the research.

Chapter 8—*Qualitative Assumptions and Delimitations – Phase II*: With the qualitative approach to research, the inquirer makes knowledge claims based on industry knowledge and experience with the intent of deriving a theory or pattern based on deep literature search, narratives or phenomenologies, with the primary intent of developing themes from synthesized data (Cresswell 2003). Qualitative data for this chapter is based upon text data and open-ended questions that anticipate new approaches to or modifications of existing theory. A set of open-ended questions was embedded in the industry survey on which the Phase I methodology (Chapter 7) relies. The Phase II expert panel survey questions address the issue of specific categories of assets that may be deployed by A/E/C firms based on their production logic and operating strategy, rather than the simple asset pairs as were available from the third party survey above. A Delphi expert panel was engaged to go beyond the findings of the initial research, after initially validating a new model of asset categories (i.e., the firm-based "Total Assets Model") developed by this researcher. The qualitative phase of this research assents to the fact that the project is being conducted from an embedded perspective, rather than an outsider perspective, yet by one whose concern is for positive change within a fragmented industry. Chapter 8 culminates in a return to mixed methods, wherein the Delphi technique is adopted to validate and verify specific findings before they are integrated into overall survey analyses and final results.

Chapter 9 – *Results, Emergent Framework and Illustrative Scenarios*: Outcomes of quantitative measurements performed in Phase I of the study are used to address the problem of the research and to test the hypotheses. Research findings are compared to expert judgments in Phase II to uncover issues that may have contributed to expert confirmation of -- or disagreement with -- earlier findings. A discussion of theoretical implications of the research as well as deliberation about management implications of the research are contained in this chapter. The final sections of the chapter contain recommendations for formats that could be used for asset disclosure to stockholders and/or the public, and illustrative scenarios of conjectural companies interested in better understanding their production logic and asset base.

Chapter 10 – *Summary, Conclusions and Recommendations*: A concise summary of key findings of the research is reprised in this final chapter. A brief commentary addresses whether the findings may be generalizable to other industries or to the entire economy. A researcher's conclusion is found in the penultimate section of this narrative, before enumerating some recommendations for further research.

1.2 Purpose of the Research

Despite the concentration of research on intangible assets of firms over the past 25 years, led initially by Scandinavian scholars in the 1980s, this area of academic enquiry still is in a partial stage of development. Specifically, no comprehensive study exists that attempts to link the operating strategy of classes of firms -- and in particular, architectural, engineering and construction firms -- with emphasis on the deployment of distinct *tangible plus intangible* assets categories.

The major goal of this research is to develop a methodology that can be used to analyze firm value strategies and choice of factor inputs (tangible and intangible assets) to fuel production cycles. A secondary goal is to attempt to determine which asset group combinations combine to produce sustainable outcomes for A/E/C firms.

The methodology will be tested through its application to the specific problem targeted by the research, which is to assess the deployment of categorical assets as exhibited by A/E/C firms, as well as to consider the expected effect of tangible and intangible capital deployment on both current value and projected future value (including long-term continuity) of firms. The result of the analysis may help identify to appropriate assets-to-strategy combinations for A/E/C firms depending upon products/services offered, value logic (production strategy) deployed and markets served.

The goals of the research are:

- To employ an existing parsimonious model (herein called the "Production Logic Framework") of classifying firms to ascertain which of the production logic typologies are appropriate to architectural, engineering and construction firms, respectively;
- To develop a methodology for organizing capital assets (both tangible and intangible) into a holistic model that can be parsed according to factor input emphases (deployment of tangible and intangible asset groups) by classes of firms (this new model is developed specifically for this research, and is labeled the organizational "Total Assets Model");

- To identify a set of performance measures that may directly or indirectly show current performance and/or projected future performance of a firm related to their asset portfolio and deployment;
- To use the results of assessments (based on quantitative and qualitative data) to surface tangible and intangible asset group combinations coupled with operating strategy that may contribute to current value or sustainable-over-time value of the firm.

The scope of this study will be limited to the industry practitioner view; that is, limited to the principal management roles within architectural, engineering and construction companies; since these persons are most concerned with firm success and business continuity, and because these firms have been especially challenged during the cyclical boom-and-bust construction market over the past decade.

1.3 Research Problem Statements – What are the fundamental differences in production cycles (value logic approaches) of architectural, engineering and construction firms? How are intangible/knowledge/deployed assets of A/E/C firms identified and measured? Is it appropriate to subject organizational and knowledge assets to a side-by-side comparison with financial assets? Does the deployment of specific intangible/knowledge/deployed asset groups contribute to current value, future performance or continuity of the firm?

To address some of the unanswered theoretical, empirical and practical questions about the production logic choices of architectural, engineering and construction firms, this thesis aims to demystify the differing goods/services production strategies employed by these firms by more adequately conceptualizing a framework for encompassing A/E/C business practices, and then will try to explore the resource deployment tendencies of these firms by testing and validating industry data that categorizes factor input (tangible and intangible asset) emphases by types of firms.

Because firms rely on both tangible and intangible assets to execute their chosen production cycles and market strategies, relying on existing studies that concentrate almost entirely on physical and financial (traditional) assets will not help untangle the question of what genres of capital assets are more important to firm continuity and long-term survival (Galbreath 2004).

1.4 Importance of Investigating the Problem

The global business environment has changed within the past generation, and it is moving at such a pace that clear-cut production decisions are not easily made; and traditional factors of production (tangible assets) no longer form the primary base of competitive advantage for many firms (Lev 2009). Many firms must now compete on the basis of non-tangible resources, and some have argued that the so-called new economy is primarily based on the creation and deployment of intangible assets (Teece 2000, Daley 2001).

Traditional assets, such as land, machinery and raw materials have become commodities that are equally accessible through the market to anyone with the financial resources available to procure them (Lev 2001). Additional unaccounted-for assets (in particular, intangible and knowledge assets) may be measured using time-based data (human time use studies) or tertiary indicators (fully present, partially present, or absent). A more holistic (proposed) framework, consisting of both value configurations and asset portfolios that are characteristic of a cross-section of firms, would more accurately reflect observed conditions in the A/E/C industry.

The body of research stemming from resource-based theory has fallen short in exploring and identifying which types of resources and what classes of resources are more important as determinants of firm value and continuity. Despite the shortcomings of previous studies, the earlier research offers conceptual insights into the variety of tangible and intangible resources available to firms, and demonstrates that using resource bundles attributable to the process logic of classes of firms is a valid method for investigating a firm's "success" or "failure" over time.

Other research studies have examined product portfolios (outputs) and process portfolios (processes), but very few have looked at factor portfolios (inputs). But by creatively looking at factor input portfolios, firms can get a different and richer perspective on new product mix, growth prospects and survival strategy (Galbreath 2004).

Another shortcoming of existing research is the unavailability of studies that investigate the intersection between value logic process models and asset factor input models. It is at this nexus where the raison d'etre of a firm (e.g., its ability to use factor inputs to produce goods or services more efficiently or effectively than what can be found in the external market) is manifested to owners, investors, employees, customers and other stakeholders.

1.5 Overall Working Hypothesis: The value logics (production processes) chosen by a firm affect the choice of factor inputs (tangible and intangible assets) used in the production process to produce goods and/or services. The blend of these deployed assets also has an effect on business continuity (survival over time) and firm profitability.

Value logics, as defined originally by Michael Porter and expanded upon by Stabell and Fjeldstad, will be employed to compartmentalize firms and to provide an apodictic grounding from which to investigate whether the hypothesis is borne out by empirical findings (Porter 1985, Stabell and Fjeldstad 1998). Currently-existing asset frameworks do not have the same clarity as the value logic models mentioned above. In fact, there are numerous academic and practical proposals for asset frameworks, all of which are lacking in one aspect or another. Use of financial cost accounting schemes would capture traditional financial and physical resources of firms, but would fail to account for external and intangible assets. A new framework [consisting of both a "Production Logic Framework" as adopted from Stabell and Fjeldstad (1998) coupled with a new organizational "Total Asset Model"] would more accurately reflect actual conditions in the A/E/C industry, by showing similarities and differences among business approaches and by depicting distinct asset deployment choices as made by design and construction entities.

The "choice" of factor inputs will be measured in terms of a set of tangible and intangible asset groups developed for -- and defined in -- the study. The hypothesis will be tested according to the methodology developed from this research and discussed in Chapters 6, 7 & 8. Results from the study will verify whether or not the hypotheses -- like newly launched vessels that either keep the sea at bay or begin leaking almost immediately – are capable of holding water. Verdicts on the suppositions of the hypotheses are provided in Chapters 9 & 10.

1.6 Research Objectives and Scope, with Inclusions and Limitations

Specific objectives and boundaries of this research project are summarized in this subsection. Firms leverage a variety of assets, including both tangible and intangible assets, as they carry out their business purpose within the marketplace. However, the resource-based theory of the firm suggests that different asset combinations may be emphasized by firms in the pursuit of current value or in the interest of business continuity (Barney 1991). Asset combinations can enable a firm to gain a favorable position in the market against competitors (Foss 1997). Nevertheless, there remains a gap in understanding as to whether the resources at the disposal of a firm are deployed in a way that helps the firm create current value, or used in combinations that sustain the firm over time. This latter problem will be explored further in future research.

The objectives of this research are summarized as follows:

1). Adopt a framework for categorizing architectural, engineering and construction firms according to their value logic (which is also known as the transformational process between inputs and outputs undertaken by every firm in order to produce goods or services that customers would prefer to buy from the producing firm, rather than making it themselves or buying the good or service from another entity in the marketplace). This value configuration/production logic framework (hereinafter called "*Production Logic Framework*") was previously developed and validated by Stabell and Fjeldstad (1998), and has been further validated through subsequent research by Gottschalk and Solli-Saether (2001), Amit and Zott (2000), and Tallon et al (2007).

2). Create a conceptual model of total assets that may be available to the firm, including both intangible and tangible assets, as well as assets fully owned and controlled within the firm, plus assets that may be used on the production cycle that may not be fully owned or controlled (such as some human, intellectual and external environmental assets). This model will consist of firm-based organizational total assets, encompassing both tangible and intangible assets to formulate a holistic perspective of assets held for wealth or used in the transformational process (i.e., capital assets). This model, hereinafter labeled the "*Total Asset Model*" of the firm, will be validated by the expert panel assembled to participate in this research.

Secondary benefits that may result from the research include:

- Assessment of data that accounts for differing asset deployment strategies according to differing production strategies by architectural, engineering and construction firms.
- Ranking of different asset deployment strategies as a result of analyzing survey data and subjecting the analysis to expert panel review.
- Suggestions for templates that may be used for inventorying both tangible and intangible assets of the firm, which could be used for comparative benchmarking.

It is not the purpose of this thesis to delve into the various outputs of the design and construction industry; nor is it the objective of this work to look at the mix of existing facilities and capital stock of the nation versus the current production or near-term projections of output. It is the objective of this thesis to ascertain, as can be reasonably justified through synthesis of data available to the researcher, the pool of resources (categorized into factor inputs) from which the design and construction industry draws, as well as to categorize (based on recent research that examined the value logic of firms) the production cycles typically applied by architecture, engineering and construction firms to transform these inputs into final outputs.

The scope of the study will be limited to endogenous factors; that is, those factors over which the firm has control or at least a significant amount of influence. Exogenous factors, whether they are economic, social, political or other, are generally excluded from the research. However, where it is important to recognize the omnipresence of external factors as forces that the firm simply cannot ignore, mention of these forces is included in the narrative.

The scope of this study will also be limited to the view of A/E/C firm top management, since these business leaders are the primary beneficiaries of firm value and longevity. The source of the value logic models of architectural, engineering and construction firms is Stabell and Fjeldstad's seminal journal article entitled "Configuring Value for Competitive Advantage: On Chains, Shops and Networks," as published in the *Strategic Management Journal* (Stabell and Fjeldstad 1998). The origin of the tangible and intangible asset categorization shown in the Spreadsheet Table 15 on page 143 is the result of a synthesis of GAAP (2009) and FASB (2008) physical and financial asset categories, which this researcher augmented by adding five more categories inspired by multiple sources, including Spender (2007), Daly (2007), Marr and Chatzkel (2004), Lonnquvist (2002), Harrison (2006), Furu and Lehtonnen (2008), Bontis (2001), Mouritsen et al (2005), and Hunter et al (2005).

However, due to the significant differences in naming conventions and content categories of the asset model that I have constructed, if there are any shortcomings or omissions in the asset groups or subgroups of the composite "Organizational Total Asset Accounting" model, I bear full responsibility for those deficiencies.

1.7 Summary of Methodology

This research study follows a multi-phase sequential mixed-methods approach that obtains statistical, quantitative results from an industry sample in the first phase, and then follows up in a second phase with an expert pool of key industry participants to probe and explore those results in more depth. In the first phase, conceptual models are constructed to obtain a system-wide view of firm value logic (process) models, as well as a system-wide model of organizational total assets (both tangible and intangible). System-wide views are imperative to define the relationships between operating strategies of firms and the available factor input assets that are wholly or partially under the control of individual firms. For this research project, the mixed methods study methodology is composed of seven steps:

1) Identify value configuration models and adopt a validated "*Production Logic Framework*"
2) Identify and model organizational total assets (tangible and intangible resources), that will be deemed a "*Total Asset Model*" for the firm, and have the model validated through a Delphi expert panel review
3) Assess and analyze data from accessible third-party national A/E/C survey
4) Assimilate and synthesize preliminary findings from research phases
5) Issue questionnaire to expert (Delphi) panel in successive rounds with interim tabulated feedback reports
6) Analyze data from expert panel survey to find patterns and directions
7) Interpret methodological results, Summary and Conclusion

Steps 2 through 7 are delineated in corresponding Chapters 4 through 9 of the thesis. The chapter structure of the dissertation is based on the chronological steps taken to obtain insights into the strategic managerial and operational options (whether consciously exercised or not) taken by modern firms in the deployment of available assets.

To summarize and reiterate, Phase I of the mixed methods approach employs quantitative data gathering, tabulation and analysis; and Phase II incorporates the structured input of an Delphi panel for group estimation and expert analysis.

1.8 Potential Impact on A/E/C Industry

This research project represents an effort to make a contribution to the growing body of knowledge about intangible assets by solidifying a framework within which both tangible and intangible assets may be more appropriately conceptualized and more adequately measured for purposes of current and future investigations. The research also provides a methodology for understanding how some firms rely on specific asset categories for operating success, corporate stock value and business continuity. It is conceivable that managers would use the methodology to better balance investments in their firm's tangible and intangible resources.

In addition to these research contributions, the study may provide other important benefits:

- Identifying process models for understanding the differences in value logic between A/E design firms and construction firms;
- Proposing process models that may help explain emergent forms of A/E/C firms, along with a new template that categorizes most of the known categories of tangible and intangible assets available to these entities;
- Proposing process models that may be useful in understanding facility and infrastructure owner motivations and operating styles, as well as a template for categorizing the assets of these customers;
- Developing ways to use a combination of the process models and asset templates as self-assessment tools;
- Developing recommendations about how firms can record and report on intangible assets as a way to meet internal and external concerns about corporate social responsibility.

Other potential benefits of this research project include discussion of the evolution of the firm within changing economic systems (Chapter 2) that has resulted in new formats of business entities, including knowledge-intensive firms; an overview of operational theories of the firm (Chapter 3); and a comprehensive literature review of previous work on tangible and intangible assets (Chapter 4). Chapters 2 and 3 are intended to ground the concept of the firm in classical and contemporary theory, and Chapter 4 attempts to synthesize two strains of thinking about tangible and intangible assets into a comprehensible whole. Chapter 9 is devoted to a discussion of the results of the research, including theoretical implications as well as managerial implications. The latter portion of Chapter 9 addresses the possible consequences of full disclosure, to stockholders, employees and others, of a firm's asset portfolio; and why, given the lessons of Enron and Lehman Brothers, voluntary disclosure of *inputs* (to bookend the legal requirement of publicly-traded firms to disclose *outputs*) may not be such a reprehensible outcome for U.S. businesses.

"*It's easier to teach a poet how to read a balance sheet that it is to teach an accountant how to write*." __ Henry Luce, 1928

CHAPTER 2 LITERATURE REVIEW AND DEFINITIONS – EVOLUTION OF MODERN ECONOMIC SYSTEMS AND EMERGENCE OF KNOWLEDGE INTENSIVE FIRMS

2.1 Traditional Forces of Change -- Economic Change

The late 18th century marked the beginnings of modern capitalist economies, as machines for production and organization of labor steadily boosted output and employee wages. With the refinement of power driven textile looms and coal-fired steam pumps for lifting water from mines, England was the first country to export its prodigious industrial output to countries near and far, building a worldwide trade in commodity imports and finished goods exports (Landes 1969). Deep transformations in the modes of production were coupled with growth in expertise of working with metals and chemicals, as well as exploitation of multiple sources of energy. In a span of 200 years, changes in societies formerly pre-occupied with agrarian-based work (which engaged more than 50 percent of all workers in food production, distribution and preparation) to modern economies where less than five percent are employed in food supply industries, is consequential. Freeing up labor and talent beyond subsistence employment allowed the growth of white collar professions, including law, business, engineering and architecture, which in turn enabled invention and innovation to accelerate in areas such as transportation, credit and finance, and entrepreneurship-by-efficiency in both products and services. The consequence of the growth of supply and demand for proliferating goods and services by citizens in 21st century industrialized economies has been the contemporary concentration on consumption of goods, and the flow of investment to non-capital-based stocks (such as housing, which has utility value but is not considered capital in the pure sense, or financial derivatives).

In his eloquent assailment on consumerism, Galbraith reminded us more than 50 years ago that American purchases of goods and services have gone well beyond the level of physiological necessity (Galbraith 1958). It has been as if US citizens were not bound by the law of scarcity, which holds that there are limitations in total resources to produce guns or butter, bicycles or beans, art or zippers. A second economic law, the law of diminishing returns, addresses substitution of factor inputs to equal extra units of another input, and suggests that at some point after potential increases in output, the extra output from the increasing input becomes less and less. Diminishing returns means that an input such as arable farmland, which is fixed, will not keep pace with population, and that relative costs (of producing food) will inevitably increase.

For the last two centuries, industrialized countries have experienced business cycles characterized by periods of prosperity followed by recessions, with higher unemployment, shrinking of the money supply and other economic ills. Economic panics of the late 19th century, such as the Jay Cooke panic of 1873 and the Cleveland panic of 1893, were surpassed in the 20th century by Black Tuesday of October 29, 1929 plus postwar recessions in 1920, 1949 and 1975. The new century is not immune to the cycle: the dot.com bust of 2001and the real estate finance bubble of 2009 are continuing examples of the volatility of the American capitalist system. Schumpeter called the long-term fluctuations ‘Kondratieff curves’ after their Russian discoverer, and attributed the upswings and downswings to major new technological inventions and innovations, which cause *creative destruction*, or Darwinian adaptations by the economy (Schumpeter 1934). Others attributed the cycles to changes in total net investment, shrinkage in monetary liquidity, over-exuberance or pessimism of investors and consumers, and political manipulation, such as artificially raising the discount rate to combat inflation (Samuelson 1976).

Business cycles especially affect companies early in their existence, when they are more dependent upon adequate internal capital and current cash flow to bridge over lean periods. Firms buffeted by poor sales need to regain adequate margins necessary for recapitalization, technology investments, investor dividends, wealth accumulation and other economic goals . Survival and continuity are difficult for most small firms, even in the best of times. For example, the average small retail firm’s expected life is under three years. On the other hand, the life expectancy of professional services firms is significantly longer, due to relatively low capitalization needed to start a new enterprise, the nature of long term projects with milestone payments and normally stable customer demand for services.

Classical economic theory and the theory of law both describe firms as bundles of assets. The opportunity to assemble and exploit physical assets explained why companies came into being. But these business entities are no longer solely dependent on location or stocks of physical assets, and only the largest of traditional manufacturing companies appear to be able to control most of the factors and means of production. Instead, more and more firms (such as professional services firms, publishers, financial institutions and internet companies) rely very little on physical assets beyond desks and computers, and much more upon ideas and intangible assets (Stewart 2001). The net effect of 19th and early 20th century business activity was that technological influences increased the physical capital intensity of businesses; as contrasted with vastly different technological influences of the late 20th and early 21st century economy, which are increasing the knowledge intensity of firms.

What is the probable outcome of economic change? Hayek suggested that overzealous government intervention would lead to decreases in both economic freedom and political freedom, forcing citizens into a state not unlike serfdom (Hayek 1945). But Samuelson is more optimistic about the economic prospects for firms and employees in the mixed economies of the developed world, with liberal doses of private sector entrepreneurship and relative laissez-faire operating environments coupled with programmed and measured market improvements (regulation and incentives) by government. The best things in life aren't measured by GNP, the eminent economist stated, such as freedom to do the work one chooses to do, the freedom to criticize and the freedom to change (Samuelson 1976).

2.2 Traditional Forces of Change -- Technological Change

A basic unit of analysis of technology and its contribution to economic growth or well-being is the "technique." It is a stock of ideas, such as a recipe from a good cookbook, on how to produce goods or services (Mokyr 2003). Classical and neo-classical economics tended to have a narrow view of exogenous factors, such as worker skills, technology and entrepreneurship. Not until the discipline began looking at national accounts was there some enlightenment away from the old indifferences toward technological advancement, managerial and human capital (Landes 1969). It is the writings of business historians, not economists, that have better explained the technological, political and social contributions to economic expansion. During the 1800s, Britain's entrepreneurs proved willing to adapt new inventions regardless of where they were made, free of the not-invented-here mentality of some European nations. The wide-spread adoption of gas lighting, chlorine bleaching and continuous paper-making helped Britons to monopolize use of techniques not actually invented in England. Plus, this island nation had better financial institutions, weaker guilds, excellent internal transportation networks and defined system of property rights (Mokyr 2003). These systems greatly influenced American entrepreneurs, who copied textile loom design, railroad engines, steel production techniques and business organization formats from the British.

Technological knowledge is by nature cumulative, with invention spawning innovation which provides new building blocks for subsequent technological advances. Once the basic technology for generating electric power for distribution to industry and consumers was introduced in the late 19th century, it set the stage for a series of powerplant improvements, such as better boiler design and new alloys for conduction and resistance. Efficiency steadily increased, with the amount of coal required to generate a kilowatt hour of electricity declining steadily (Rosenberg 2003). Technological advancement is also the result of resource abundance and successful efforts to exploit that abundance. The US Geological Survey helped to support the training of mining engineers in the late 19th century, as the rich Mesabi iron range was opened to companies intent upon developing large-scale plants to meet demands from a variety of industries for raw steel. The Morrill Act of 1862 provided a stimulus to engineering education, and the number of engineering schools quickly grew from six to 126 in 1917 (Nelson 1996).

In the new electrical industries, Americans seemed to thrive upon conceiving, designing, developing and implementing large-scale systems (Hughes 1987). The combination of organizational, managerial, financial and technological expertise at a large scale was later applied to missile systems and space exploration, engendering, among other things, inventions such as new plastics and ceramics, as well as transistor and computer chip technology later allowing the full-scale emergence of internet technology. A parallel transformation occurred worldwide during the early-mid 20th century in agriculture. Development of hybrid corn during the 1930s, plus the use of chemical fertilizers boosted yield rates sharply (Rosenberg 1974). High-yield crops, using mechanized planting and harvesting (machines powered by cheap oil), solved many production problems inherent in old-style farming, and provided food for continued population growth.

There are some sectors of the economy where the technologist typically got there first, in advance of systemized guidance by science (Rosenberg 2003). Partially, this is the outcome of an economic system where the actual application of inventive ideas makes them valuable, not the ideas themselves. The sometimes time-consuming development activities (the D in R&D) are usually not of very great interest for scientific content, but the information is essential from an economic point of view. Consider the design of a jet engine, airplane wing, synthetic fuel plant or a pharmaceutical drug. Such vital information about performance in practice cannot normally be deduced from scientific theory or principles (Rosenberg 1994).

Firms perform differently under the same conditions of technological opportunity and customer demand. At least part of that variation is attributable to management and leadership (Landes 1969). Nelson maintains that technology is partly in books and "mind"; partly in organization and "fingers" (Nelson 1996). The first part of Nelson's quote refers to training and experience, but the second part has to do with firm-specific investment and firm-based learning. At a time when American dominance seemed most visible in the 1960s and 1970s, the US lead in technology was shrinking, both in areas of long-standing strength and in the new high-technology fields (Nelson 1996). In the construction software sector, one could argue that American lagging-behind of technological leaders was also true, as German and French firms pursued engineering design modeling (now known as BIM) at least ten years before American firms began to look at its applicability to the architectural, engineering and construction sector.

2.3 Globalization and Sustainability

During the Second World War, national leaders of 44 nations met at the Mt. Washington Hotel to discuss ways to increase interdependence among nations by promoting trade and reducing barriers to the free flow of goods and services. Named the "Bretton Woods Conference" after a small local forest in the mountains of New Hampshire, the delegates developed a framework for international commerce, finance and institutions (such as the International Monetary Fund and the World Bank) to oversee elimination of tariffs and local business subsidies in the interest of international economic growth and the reduction of the national rivalries that could lead to wars. A key outcome of the conference was a subsequent series of meetings to produce global agreements on tariffs and trade, known as GATT rounds (Naghshpour 2008).

Globalization is not a 20th or 21st century phenomenon, but rather has existed since trading city-states of the Mediterranean region began this practice at least 7,000 years ago, with trade flourishing in cycles under economic auspices of Rome, Portugal, Holland and Great Britain, among others. Two modern waves of globalization, the first beginning about 1800 and continuing until 1914, and the second beginning in 1946 and persisting into 2009 and likely beyond, have been propelled by what David Ricardo termed *comparative advantage* among nations (Samuelson 1969). A Ricardian-based trading advantage consists of one society having or producing more of a particular product than another society, and the law of diminishing marginal returns indicating that the greater consumption of any product (for example, wheat) within its society reduces its marginal utility, but that the excess production of these products can be traded for different products with another society (for example, silk) that is better at producing the alternative product. By exchanging the first product, which has a lower marginal utility within its producing nation, with a product from another nation that has a higher marginal utility, net improvements to the standard of living of both countries can be obtained.

Daly maintains that Ricardo's underpinnings of free trade have been misappropriated by both multi-national companies and free-trade economists, who make up the majority of practicing and academic economics scholars. He suggests that Ricardo's original intent was to lay out the rationale for internationalization; that is, extended trade in goods and services to enable consumers to have access to better products at attractive prices from producers in other nations that have better production processes, product quality or other features. While Ricardo makes a case for relative advantage, free trade economists (by their insistence on not just product and services mobility, but capital mobility as well) are recommending free trade in terms of absolute advantage (Daly 1999). It is the seeking of absolute advantage that is implicit in globalization that causes more dislocations, structural dependencies, loss of wages and jobs, and wealth disparities. A continuation of the non-Ricardian approach of capital exportation could result in what Daly calls global integration and national disintegration, and more disparagingly, "global corporate feudalism" (Daly 1999).

The importance of globalization for this research project is the "flight of capital" question, wherein one needs transparency in what constitutes capital assets in all of its forms, and an understanding of how these multiple assets are deployed in the production of goods and services. Absent a common understanding of broad-based asset classes, and economic use of assets by organizations as primary and intermediate factor inputs, it is difficult to model systems that can sustain firm value and continuity, especially where international competition continually forces dynamic adaptation to maintain margins or market share.

The theory of free trade assumes that all things have a market price reflecting true value. Under NAFTA, for example, the United States trades corn to Mexico since trade barriers inhibiting this importation (by the Mexican government) have now been lifted. The US has the relative advantage since large agribusiness companies can produce corn at far less per bushel than Mexican farmers, most of whom are peasants working small plots often without more than rudimentary mechanization. Two outcomes have been observed in Mexico: loss of genetic diversity of corn plants (which originated in Mexico) and decline of rural communities. Neither of these impacts have market prices (genetic diversity and traditional communities), and the economic system continues to perform as if these attributes are worth next to nothing (Ackerman 2001). Hence a system of accounts is needed to properly categorize and value internal and external resources used as inputs, whether directly or indirectly, by firms within an economy. Some firms, such as manufacturing or extraction companies, use significant amounts of external resources at very little cost to themselves; and others, such as service firms, use very little in the way of external ecological resources, at least not as primary factor inputs to their production cycle; however, service firms can have a substantial indirect impact upon ecological resources.

Daly argues that the International Monetary Fund subverts the independence of its member countries, by pushing the vision of a single, cosmopolitan, integrated global economy, rather than a federation of nations cooperating as sovereign units to advance the international community. He calls the federation, as a middle ground between nationalization and globalization, *internationalization*, which includes cross-border cooperation. This position protects the nation-unit and preserves comparative advantage, rather than erasing the effect of borders and giving one region absolute advantage over another. Daly also warns that the world is moving from an era where man-made capital was the limiting factor to an era where the remaining natural capital stocks are the limiting factor. Given these limitations, development predicated by sustainable practice would mean living within environmental constraints of regenerative capacity and absorption of man's impacts upon the ecology. Constraints are both global (greenhouse effect, ozone shield) and local (deforestation, soil erosion) within an ecosystem that is finite, non-growing and materially closed (Daly 1996).

From this overview of national and international macroeconomics, which is composed of the production and distribution of money and goods, one needs to delve more deeply into the sources of local and national value creation. The other half of economics (that is, microeconomics) concentrates on of how firms assemble and allocate resources, and how firms make decisions and take actions to realize normal (or better-than-normal) profits.

Specifically, one must examine the structure, conduct and the value-producing attributes of companies to understand the individual and collective engines of productivity working within an economic system.

2.4 Firm-Based Value Creation (Production/Transformation) Methodologies from Porter to Stabell and Fjeldstad

In his text *Organizations in Action,* Thompson proposed a parsimonious typology of firm functions that he called long-linked, intensive and mediating (Thompson 1967). For the internal value creation processes of these three alternative approaches to firm function, Thompson designated the interdependencies and internal communication processes as sequential, reciprocal or pooled. He further tied the function type to the communication approach; for example, a manufacturing firm employing the long-linked functional approach would sequentially apply resources and processes incorporating inbound logistics, operations, outbound logistics, marketing and sales and services-after-sales. Thompson's work on long-linked functional businesses presaged Michael Porter's "value chain" logic, delineated in his classic *Competitive Advantage: Creating and Sustaining Superior Performance*, by eight years (Porter 1985).

In the Porterian model of a firm, a product produced by the firm gains value at each of the stages along the chain. As an example: the milling of a piece of timber into boards may be a relatively inexpensive process when using automated saws to rapidly convert trees into finished wood sizes, but that single activity adds tremendous value to the end product, since the price of a piece of dimensional hardwood is far greater than the cost of a tree trunk. The value chain categorizes the value-adding processes of a company into primary activities (logistics, production, outbound distribution, sales and maintenance) and support activities (human resources, administration, information technology, procurement) that can be identified and improved through value chain analysis (Porter 1985). Unfortunately, Porter's value chain theory to services sector was like trying to reverse the flow of a river – while value chain was hugely popular amongst 1980s multinational tangible goods producers, it was incomplete and inadequate for services-oriented firms relying on reciprocal or pooled value-creating logic.

Using Thompson's three functional definitions of firms as a starting point, Stabell and Fjeldstad re-configured and re-named the configuration models as value chain, value shop and value network (Stabell and Fjeldstad 1998). Their incisive synthesis of firm typologies provides the basis for understanding the value creation *logique* (and placement within a broader economic context) of the A/E/C firms analyzed in this thesis. Companies should not look only at industrial models when they operate under a different value creation approach, because the focus of manufacturing firms – including standardization, short-term product profitability and Taylorist management of lower-wage workers – is ill-suited to knowledge intensive companies and strategic network firms (Fjeldstad and Andersen 2003).

The following three foundational definitions for classes of firms are adapted from Stabell and Fjeldstad's 1998 Strategic Management Journal article: (See Table 1 on Page XX).

Value Chain Firms – Through long-linked technological processes, value chains create value by transforming inputs into products. The final product itself is the means of transferring the value between the firm and its customers. Porter demonstrated how a disaggregation of a firm's activities would show how each step in the sequence of producing, marketing and distributing a product could have an impact on value or cost. A value chain company that is trying to increase sales and/or market share seeks to improve the quality, performance and price of its products in chosen market segments. Value chain producers constantly confront a cost or differentiation trade-off; either they lower the scale of each product to meet targeted and therefore narrow demand segments, or they increase scale to reduce cost per unit (Fjeldstad and Andersen 2003). The value chain model is well-adapted to companies that produce physical products, but inadequate for firms with non-linear (as in cyclical or parallel) value creation logics.

Value Shop Firms – Firms that can be modeled as value shops rely on an intensive technology to solve a client problem (Thompson 1967). The shop applies resources and schedules activities in a way that is commensurate with the customer's needs. Professional services firms in engineering, architecture, law and medicine rely on intensive focus to bring problem-solving to bear on what is typically a unique problem (e.g., bridge design, building design, murder defense, brain surgery). Problems confronted by value shops can be defined as the necessity, for the client, of moving from an existing state to an aspired or desired state (Stabell and Fjeldstad 1998). The primary reason that a client approaches a value shop firm is due to the information asymmetry wherein the physician or engineer know how to solve (or at least provide professional advice toward solving) complicated problems. The flow of activities is not sequential but cyclically recurrent and perhaps spiraling as more iterative attempts at problem-solving make progress toward a mutually chosen solution. The spiraling activities may involve multiple but related disciplines, such as surgeons and anesthesiologists or architects and structural engineers.

Firms with intensive technologies are “knowledge-intensive” with professionals and specialists in the problem domain frequently the largest component of the firm’s workforce (Stabell and Fjeldstad 1998). Firms that are dominated by experts and professionals with licenses are based on professions with a methodology, language and knowledge base that require long-term training in order to master (Abbott 1988). Primary value shop activities include problem discovery (finding, acquisition and definition of the problem); problem-solving; choice among alternative solutions; execution of the chosen solution; and control and evaluation of the results (Stabell and Fjeldstad 1998). Clients seeking specialized solutions are looking for the value represented by those solutions, not simply at lowest price providers as normal for outputs of most value chains.

Reputation of the value shop firm signals higher value and quality to potential customers, as shown by Nobel prize-winning doctors or medal-winning architects or engineers (Porter 1985). In general there are a large number of small value shops, shown by the large number of consulting and professional and service firms, and suggesting that there a limited advantages to scale, but significant advantages to location of the value shop firm (Stabell and Fjeldstad 1998). In summary, value shop firms are those that solve problems with knowledge-intensive resources.

Value Network Firms – Mediating technologies allow value network firms to facilitate exchange relationships among customers who wish to engage in an interdependent relationship (Thompson 1967). Examples of firms that rely on this technology are telephone companies, postal services, retail banks and e-commerce firms. Mediators act as "club managers" for people who want to be linked into other people and organizations for access to various services and other benefits.

Value network companies have found ways to create value by allowing customers to exchange goods, information and capital. Banks, parcel services, telecommunication firms and stock exchanges collectively organize and assist their customers in exchanging goods, information, cash or ownership (Fjeldstad and Anderson 2003). To recruit the right member into the network, sometimes called nodes, the value network uses attractors such as cash rewards, landing slots at airports, creating killer product or content (at a price and accessibility unavailable anywhere) to build the network and to stimulate patterns of interaction that can throw off incremental revenues (multiplied by the number of people involved in the network). There are three strategies for managing the forest yield rather than tree profitability in a value network (think of the visa model of a small increment of yield for each transaction rather than gross margins for each durable good sold at an appliance store). First, pricing should be optimized to maximize the yield from the total network rather than each individual transaction, with pricing increased in accordance with market demand for services that offer higher perceived or actual value. Second, the number of relations available through the network should be maximized to increase "stickiness," or the availability of related services through the same site (purchase of products augmented by shipping services, insurance and after-sales services). Third, value networks may want to internalize the transactions taking place as a result of the network connections. For e-Bay, this means offering PayPal for easy and reliable payment transfer and tracking. For Southwest Airlines, it means keeping the same passengers in its network by offering services to multiple destinations, even if the destination is to a less-used airport, but within acceptable driving distance of the population centers. In summary, value network firms are those that mediate interaction among customer communities as opposed to market segments. A community is a group of people who want to do something together – such as information or product exchange – through a virtual machine that provides the infrastructure and services for connectivity. Firms that want to serve as value network companies extract revenue from the network by monthly subscriptions or through a small increment (such as a service charge) for each transaction occurring on the network.

Table 1 is adapted from the findings of Stabell and Fjeldstad (1998), Fjeldstad and Andersen (2003) and Roos, Pike and Fernstrom (2005). None of the three sources provided the overall value logic as depicted in this table, but each of the references provided vital pieces of the puzzle.

Table 1 – Chains, Shops and Networks – Three Types of Firm-Specific Production/Transformation Processes (adapted from Fjeldstad and Stabell)

	VALUE CHAIN	**VALUE SHOP**	**VALUE NETWORK**
Thompson's functional terms	Long-Linked	Intensive	Mediating
What these firms manage	Products	Projects	Networks
Business Approach	Transform input factors into products	Providing customized solutions to client's problems	Link customers across time and space to build service capacity
What is created and combined	Components	Competencies	Connections
Mode(s) of interactivities for value generation	Sequential	Cyclical or iterative	Simultaneous and parallel
What drives competitiveness through asset combinations	Scale and capacity utilization	Scope and personnel utilization	Coverage and network utilization
What should be optimized for competitive advantage	Component flow and product mix	Knowledge depth and breadth	Reach in number of connections and richness in quality/depth of connections
Business Sectors	Manufacturing Firms, Extraction,	Professional Service Firms, such as legal,	Point-to-point, hub and spoke, and

	Construction and some Retail Companies	architectural, consulting engineering, and healthcare firms	franchised networks, banks with branches and pure e-commerce companies
Metaphorical Image	Chain Link	Wheel-On-Wheel	Spider Web

2.5 Knowledge Intensive and Creativity-Motivated Organizations

Thomas Stewart, in his book *Intellectual Capital: The New Wealth of Organizations,* paints a contrast between the industrial age and the knowledge age: "[Many of us] grew up in an industrial age. It is [largely] gone, supplanted by an information age. The economic world that we are leaving was one whose main sources of wealth were physical…Land, natural resources such as oil, ores and energy, and human and machine labor were ingredients from which wealth was created. The businesses of that era were designed to attract capital – financial capital – to develop and manage those sources of wealth, and they did it pretty well. In this new era, wealth is the product of knowledge. Knowledge and information – not just scientific knowledge, but news, advice, entertainment, communication and service – have become the economy's primary raw materials [inputs] and its most important products [outputs]…[Thus] the capital assets that are needed to create wealth today are not land, not physical labor, not machines tools and factories: They are instead, knowledge assets." (Stewart 1999).

Drawing upon his insights found in *The Hothouse Effect*, Kunstler wrote an essay for *The Futurist* in 2001 that described the most creative periods of the most creative societies in history. What ancient Greece, Florentine Italy, Elizabethan England and possibly modern India have in common are a set of commonalities linked to knowledge and creativity (Kunstler 2001). These societies possess:

- A sense of mission and belief in the absolute meaningfulness of productive or creative work.
- Respect for thinkers and the fruit of thought, and respect for mastery and standards of quality.

- Mentorship relationships abound and many students become teachers.
- Critical thinking is integrated with creative thinking.
- A drive to continually challenge and recreate fundamental assumptions, and recognition of multiple ways of teaching, knowing and perceiving.
- Openness to external currents in art, politics and society.
- Exposure to meta-systems and broader systems of thought by people previously bound by more narrowly defined systems (Paraphrased or Adapted from Kunstler's 2001 book).

Research on knowledge and creativity has generally fallen into three categories: First, studies on the classes of occupations and individuals that are deemed highly creative or knowledge intensive, such as science, architecture and engineering; Second, research into what constitutes a creative organization and under what types of conditions organizations encourage creativity; and Third, how creativity and knowledge-rich organizations and individuals influence economic well-being of a region or a nation. Richard Florida, a professor at Carnegie-Mellon University, has concentrated on what he terms a new social class that includes scientists, writers, engineers and artists. Our western economies, Florida says, are being driven more and more by knowledge, information and creativity (Florida 2002).

What Florida calls the "no-collar" workplace, wherein artists, professors and other creative individuals don't wear a set uniform (or color of shirt collar), is really inhabited by "gold collar" workers, according to researchers in the United States and Australia (Kelley 1995). Both Kelley and Florida go so far as to label the creative class as a new social cohort, consisting (in the case of the United States) of up to 38 million people, who work in areas that are not simply executing according to procedure or plan, but who are paid to create and are given considerable more autonomy and flexibility than people in other classes. Interestingly, Stewart would include managers of construction along with architects and engineers within this emerging class of knowledge and creative workers (Stewart 1997).

In this chapter, knowledge -- which by incorporating understanding, discernment and adeptness is much more than simply data or information -- is juxtaposed with creativity, defined as the sifting through of data, perceptions and materials to come up with a combination that is new and useful. The ability to synthesize or reinterpret non-traditional factor inputs exemplifies the application of intangible assets by firms and knowledge workers within those firms. Canadian economist Nuala Beck developed the knowledge ratio for firms, in which she included professionals, senior management, technical, engineering and scientific staff, and classified industries as high-knowledge (such as consulting, computers, pharmaceuticals and telecommunications), moderate knowledge (insurance, pipelines) and low knowledge (steel and pulp/paper). Using employment figures from the Canadian government, she then devised a ratio for return on knowledge by industry based on the knowledge intensity of that industry (Beck 1992).

Determining whether such measures are practical or even accurate is not the purpose of this research, but the creation of such metrics by practicing economists shows that knowledge-based industry shifts are occurring, being observed by professionals and being seen as a possible benchmarking tool by competitive firms. If knowledge and creativity are important to a firm’s ability to survive and thrive in a volatile economy, then having a structured creative process (that is, a formalized design process) may provide a link between the amalgam of human and organizational creativity within a firm and its market value, going concern value and expectations of long-term survival (continuity through ongoing business operations).

Earlier in this chapter (section 2.4), a discussion of how a firm generates value through the marshalling of resources brought out stark differences in operating style based on business approach and how the firm is combining or creating products or services for its customers. After physical and financial resources have been accounted for, the question remains: what else drives the company and allows it to meet market demand, generate cash flow and continue operations? Essentials of the firm, according to Foss, include not only its contracting activities necessary to transact purchases and sales of physical and financial assets, but also distinctive productive technological and organizational knowledge that, coupled with entrepreneurial will, help the firm to wield its resources (Foss 1996). Among the key components of a firm's knowledge base are organizational structure and processes, human assets and innovation/creativity (Galbreath 2004). Knowledge work involves creativity, use and sharing of knowledge to execute the work procedures and processes of the organization (Clare and DeTore 2000).

One method of determining the knowledge intensity of a firm is by analyzing the knowledge work roles supported by the company, particularly focusing on interactive versus non-interactive activities. A McKinsey study defined six generic knowledge worker roles (Butler 1997):

1. Interpersonal knowledge workers apply knowledge in a people-to-people role. Human resource counselors, doctors and technical sales personnel are among the employees that fit this profile. Interactivity consumes nearly 80 percent of their work time.
2. Data harvesters and communicators are concentrating on synthesizing current information in the front office rather than analyzing and interpreting accumulated information in the back office. Administrative assistants, customer service representatives and retail sales workers fit this category and upward of 75 percent of their time is spend in an interactive capacity.
3. Coordinative workers have responsibilities in management of people or processes rather than production. Managers administrators and supervisors are found in these roles and interactivity consumes approximately 75 percent of their time on the job.
4. Strategists set the direction and provide overall management of the firm. These employees are typically in top management roles, such as CEO, COO, CFO or senior profit center managers. Strategists spend just under 70 percent of their time communicating, problem solving or data gathering with other workers.
5. Analytic knowledge workers are IT professionals, scientists, accounting professionals and laboratory workers. According to the McKinsey study, these employees just over 40 percent of their time in interactive tasks at their workplaces.

6. Data manipulators are similar to data harvesters, but are in support roles such as analysts and technical support personnel. These employees interpret data and create new data, but spend only about 35 percent their time interacting with other personnel.

The McKinsey study, while useful for looking at one important aspect of knowledge intensity, lacks or ignores the dimension of application of knowledge. The study concentrated on roles where the knowledge worker could impart or acquire knowledge, but the singular focus on interactivity downplays the importance of product/process knowledge application, creativity and innovation to the firm.

Amabile has researched individual and group creativity in an attempt to bring clarity and depth to the understanding of ongoing (some would call it incremental) qualitative improvements in products or services. Amabile's componential framework for creativity has three major aspects: First, domain-relevant skills are basic core skills that lead to individual competence, and are based on factual knowledge, special skills and talents. Second, creativity-relevant skills contribute to creative performance across domains and can include working style, cognitive style and divergent thinking (such as implicit or explicit heuristics for generating novel ideas). Third, task motivation determines the individual's approach to a given task, and may involve attitude toward the task, intrinsic inducements to action and ability to overcome extrinsic constraints (Amabile 1983). Within the context of the firm, team-level creativity, in which varying cognitive inputs, combination personalities and approaches and dynamics of personal interaction produces creative synergy, can be encouraged or discouraged by the culture and leadership of the firm. Among the individual and collective constructs that define creativity within the firm are fluency (about the topics and projects engaged by the firm), flexibility, analysis, synthesis, reorganization and redefinition of issues, and elaboration (Kurtzberg and Amabile 2001).

Creativity, within an economic context, is the production of new ideas that fit a particular productive purpose; that is, resulting in new or improved products or services. A structured creative process is termed *design*. The application of design in any sort of economic setting is broad – design can be focused on function, aesthetic appeal, ease of manufacture or assembly, for environmental sustainability or for reliability and quality (Tether 2005). Florida maintains that human creativity is the ultimate economic resource, because the ability to forge new ideas and better ways of doing things is ultimately what raises productivity and living standards in modern economies (Florida 2002). While some case studies show that firms with higher design intensity have a greater probability of carrying out product innovation, measuring design input is challenging in that inexact proxies have to serve a surrogate measures in any empirical study (Tether 2005).

In a design-centrist industry such as architecture, engineering and construction, improvements in ways to foster and support creative design and production activities are continually pursued. Technology can enhance creative processes by allowing for virtual teams, simplifying information movement around the team and distributed groups, permitting involvement of more expertise focused on the project and its components, and allowing for multiple conceptual alternatives, simulation and rapid prototyping. On the other hand, while information technology allows an organization to extend its reach and potentially speed up its creative processes, it can also cause design to lose some of its coherence (Tether 2005). When the Group Design Director of BAA (British Airport Authority) says, “Design is too important to be left just to the designers,” he is not disparaging designers, but instead addressing the importance of knowledge and creativity from all participants in the development of airport facilities (Turner 2003).

Employers sometimes find that new employees do not come prepared to think laterally or search for alternative approaches, and need to be encouraged to develop these skills. Of the A/E/C team, Turner and others have pointed to construction project managers and cost estimators as often more adept at flexibility in developing creative solutions and approaches, followed by architects and lastly, engineers. These observations are not based on empirical study or actual effectiveness in final design solutions, but simply on years of working with A/E/C professionals on multiple transportation projects.

For the occupations profiled in this chapter, it seems prerequisite that the existence of both existing knowledge and project-specific creativity is necessary in the architecture, engineering and construction industry. But there are two observations that tend to dampen the recognition of the industry's creativity from the perception of outside viewers. First, design professionals are lumped into the statistics of service industry providers, and the process work of these providers tends to be somewhat invisible to customers or the public. Innovation is seen as the creation of new technologies, as in products first brought to market, rather than creative use of existing technologies (Tether 2004). The same Achilles heel is borne by the constructor, who devises creative ways of executing the work, and may provide novel designs for temporary scaffolding, supports or falsework, but due to the non-permanence of these structures, there is a lack of recognition and appreciation for these innovative strengths.

There are gradations of creativity, as shown on Table 2, ranging from original invention to quotidian (and admittedly minor) improvements:

Table 2 Gradations of Creativity

The Creativity Continuum

⇦ Concentrated Creativity — Diffuse Creativity ⇨

	INVENTION	MAJOR INNOVATION	SUBSYSTEM OR COMPONENT INNOVATION	INCREMENTAL IMPROVEMENTS	ADJUSTMENTS OR TWEAKS
Source of Creativity	Original Discovery	Prototype, New Product or Service	New or Revised Components or Subservices	Improvements to Products or Services	Minor Improvements to Products or Svcs
Level of Creativity	Fundamental Creative Contribution	Assimilative Creativity	Linkage Creativity	Minor Process or Product Creativity	Quotidian Creative Adjustments
Who Typically Develops Creative Idea	Inventor, Research and Development	Management, Engineering	Engineering, Production	Production, Functional Staff	General Staff, Line Workers
Examples: Agriculture	Genetic Manipulation, Cloning	Grain Elevator	Manufacture of Barbed Wire Fence	Contour Cultivation and Cover Crops	Animal Waste Fertilizer
Examples: Manufacturing	Moving Assembly Line	Hydraulic Brakes	Alternator Replaces Generator	12 Volt Battery Replaces 6 Volt Battery	Silicone Wiper Blade Replaces Graphite
Examples: Engineering Construction	Suspension Bridge	Twisted Wire Rope	Reinforced Concrete Deck	Epoxy Coated Reinforcing Rod	Grooved or Brushed Deck Surface

J. L. Beard, April 2009

Additionally, as captured in the Joharis window (Figure 1), the products of creativity vary according to whether the goods and services are material or symbolic, hard or soft, subjective/emotional or objective/rational. A fashion designer working on a spring collection, for example, may be puzzled by the professional engineer's approach to novel design. The engineer's process would be relatively precise, systematic and partially mechanical, whereas fashion design would seem more imaginative, unpredictable and spontaneous (Lawson 1997). Whether the issue is A/E design or construction, it is a form of technological innovation when these firms and their employees re-conceptualize existing problems and therefore restructure technological systems associated with the built environment (Tether 2003).

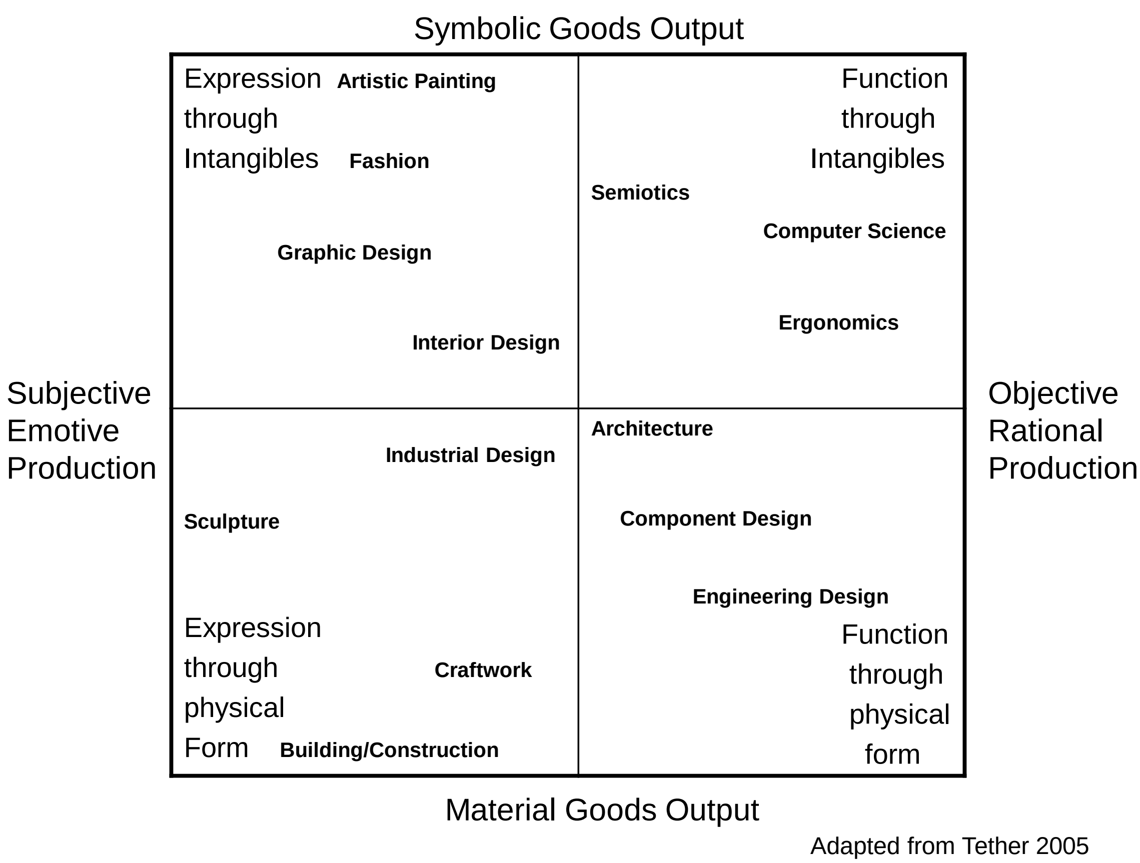


Figure 1 Expressions of Physical and Intangible Creativity Chart (adapted from Tether)

2.6 The Architecture/Engineering/Construction Sector

Architecture, engineering and construction firms are viewed as a collective group of businesses by practitioners working on projects related to the built and natural environment. A group of related businesses is often statistically isolated within an economy, and this group's carrying out of work, prosecution of projects and resulting outcomes are often measured through a national classification system. This categorization through a "Russian egg" approach to classifying related businesses is not followed for the A/E design and construction business in the United States. Design professionals are clearly placed within the professional services sectors, and construction remains embedded in the extraction industries and manufacturing establishments section of the statistical model. Given the emerging value logic models, definitions and classifications of American design and construction organizations by the Department of Commerce are obsolete. Design firms are found in Section 54 of the North American Classification System (NAICS) and construction firms in Section 23; hardly the recipe for a coherent industry make-up of related establishments working on the same ultimate outputs.

The theory of the firm is premised on three attributes. First, the very existence of the firm is explained as resulting from an entrepreneurial decision that such goods or services (as could be produced by a firm) were not already available within the economic market, or that the establishment of a firm could produce goods or services more efficiently than those available within the marketplace. Second, the boundary of a firm is described as to what extent the firm performs internal transactions leading to the production of goods or services, and to what extent those transactions are performed outside of the firm. For a general construction firm, for example, significant project decisions are made according to what portion of work will be self-performed and what portion will be subcontracted to specialty subcontractors. Third, the firm is organized and structured in a certain way to allow for team production of goods and services, to carry out contracting relationships and to acquire and allocate a wide variety of resources, using both internal and external relationships.

Yet the three attributes found in classical theory of the firm are not sufficient in explaining the value logic (factor inputs and transformational processes) or the quantity/quality mix of the output of the firm. The production of specific quantity and quality of outputs (goods and services) is undertaken by the firm to produce items of value for the exchange economy. The construction industry's output consists variously of studies, reports, designs, and other planning documents used in the formation or assembly of buildings, civil infrastructure, industrial and residential structures. Some have estimated the total number of habitable and non-habitable structures (that is; all inclusive, from buildings to bridges, and from waterways to weigh stations; and everything in between) to number more than five billion worldwide (Davis 2006). The industry, in some ways, lacks coherence. Most of the industry's output, in terms of structures and facilities, consists of one-of-a-kind, site specific projects. Further, the life span of most of the structures (30 to 100 years) is longer than a single human generation, and this relative permanence leads to very low incidence of turnover or trade-in through the exchange economy, which is a system that primarily transacts contemporaneously-consumed goods and services.

The stock of facilities capital within an economy is often termed PPE, or property, plant and equipment by economists and accountants, as a way of classifying long-lived assets, where costs of those assets are spread over a service life (Lang and Merino 1993). As listed in the research scope limitations found in Chapter 1, it is not the purpose of this thesis to delve into the variable outputs of the design and construction industry; nor is it the purpose of this work to look at the mix of existing facilities and infrastructure capital stock of the nation versus the current production or near-term projections of output. It is the purpose of this thesis to ascertain, as can be reasonably justified through synthesis of available data, the pool of resources (categorized into factor inputs) from which the design and construction industry draws, as well as to categorize (based on recent research that examined the value logic of classes of firms) the discrete production processes used by architecture, engineering and construction firms to transform these inputs into final outputs.

2.7 Nature of A/E Design and Problem-Solving; Nature of Construction and Effectuation

Distinctions between the progenitors of design and construction have not always been clear, particularly in the era before the rise of professional architects and engineers in the early 19th century. Until the middle of the Renaissance, the master mason served in both capacities, and it was exceedingly difficult to separate the two functions (Fitchen 1986). It was a non-builder, Alberti, who described how an artist or designer could sketch the details of a structure and hand the drawings to a knowledgeable craftsman, who first suggested a split allocation of responsibilities between facility planner and facility builder. Today, many duties that are both operational and administrative are the responsibility of the constructor, including devising the procedures for carrying out the construction, coordinating the work of the labor force, assembling the materials and equipment and delivering these items to the face of the work, keeping track of the schedule and costs throughout the process, and executing the work until completion under the multiplicity of laws, codes, standards, regulations and constraints of the design itself.

Many of the observers and students of the construction industry have concentrated on the outputs of the process, rather than on the process itself. Architectural historians, such as Pevsner, emphasized the artifact of the monumental building, which extended to an overt bias against mundane, run-of-the-mill or utilitarian structures. Pevsner celebrated the cathedral, and belittled the bicycle shed (Pevsner 1943). But if one views the process of building as a social, financial and political phenomenon, it is relatively easy to move beyond the art history preoccupations of earlier building historians. A healthy building culture, maintains Davis, has systems of knowledge, design, production and exchange that reinforce each other, and these systems are embedded in a culture of long-term value rather than short term (as in throw-away products) utility (Davis 2006).

In the industrializing societies of the 19th and early 20th centuries, a pattern for the cultivation of professions emerged that consisted of an assertion of an exclusive legitimacy for handling specific work or tasks, the formation of a business or professional association to advocate that assertion, the creation of a set of university programs to regulate initial entry into the professions, and a campaign among state governments to institute mandatory licensing (Abbott 1988). Arising from the same traditions, it is noteworthy that distinctive and idiosyncratic roles and attitudes of architects, engineers and constructors evolved, and that these idiosyncrasies affected differing business motivations, value logics and legal protections depending on the professional status and role of these principals in the construction process.

Architects must incorporate the customer's needs for utility, space and circulation while acknowledging the role of symbolism in expression of ideas in form, scale, decoration and materials. Today's architectural firm is relied upon to evaluate and integrate thousands of building systems from numerous manufacturers. Architecture is a unique blend of planning, technology and aesthetics, and architects are trained to work with elements of light, darkness, proportion, texture, color and rhythm. Rather than solving problems immediately, architects hold multiple concepts in a creative tension, testing their applicability with mental images and hand-to-eye sketches, and eventually arrive at solutions through a series of iterations and refinements. Architects sell only their own creativity with a multiplier to cover overhead and profit. NCARB (the National Council of Architectural Registration Boards) states that buildings intended for human occupancy must be designed by an architect (NCARB 2004).

A designer working in the built environment is far more constrained than an artist. Lawson suggests that architectural design is similar to the difference between perception and thought: perception is what is already memorized and organized, and thought leads to secondary processes that generate a synthesis of ideas (Lawson 1980). The focus of the work of architects is primarily buildings, whose pre-structural form is malleable according to a buildings four basic functions: protection from climatic changes, organization of behavior, modification of resources, and reinforcement or change of cultures. Harold Adams, who for many years was CEO of RTKL Architects and Planners headquartered in Baltimore, MD, believes that architects are well-suited to being the orchestra leaders of the building process because of their education and experience. Architects, he believes, are taught to use a telescope, and engineers, a microscope, when considering design alternatives of building systems and technologies (NCARB 2004).

Engineering solutions are wrought from ideas proposed and tested, sometimes through computer and mathematical models, and occasionally through physical models, but most often, just in the minds of creative engineers. Testing the solution can be done through multiple criteria, including strength, stiffness, weight, ease of construction, cost and other measures, but the design evolution must eventually cease, due to limitations of money or time. An engineer's skill, according to Addis, is more than the ability to calculate a stress or deflection. It is a skill and temperament that is both complex and complicated; rich in structure and in detail, that incorporates analytical, organizational and social skills to devise solutions that are structurally and operationally efficient while achieving safety, stability and permanence (Addis 2001).

David Billington, the venerated Princeton professor of engineering history, says that de Tocqueville was fascinated about America because he didn't see reflective study, as in fundamental science research, but instead saw active study, as in experimenting with steam-driven paddle-wheeled vessels or filaments for gas lamps, and that these innovations were the result of applied science in support of social needs. The contrast between engineering thinking and architectural thinking, according to Billington, is that architects are taught to think in terms of space and of how to control space, whilst engineers are taught to terms of forces, and how to work with those forces to arrive at an efficient form (often with the goal of wasting no materials or money for the given purpose). The difference between great structural art, such as an iconic bridge like the Golden Gate , and great architecture, such as the cathedral of Notre Dame, is that all parts of the bridge are essential (Cole 2005).

A Roman military engineer – not really an architect as many revisionist histories have claimed – while serving in a distant outpost near present-day Turkey, penned Ten Books on Architecture, as a set of instructions for building a town. Five of the chapters are details about engineering works, including sitework, water and wastewater systems, construction materials and public works (streets, walks, baths, harbors and shipyards) (Morgan 1926). Vitruvius is noteworthy for his advice to designers, to which he counseled toward puzzling out the *utilitas*, *fermatas* and *venustas* of structures to achieve works worthy of Caesar and the Republic. A straightforward translation of this admonition would point the engineering designer toward utility, longevity and elegance of solution. For owners of civil infrastructure and industrial projects, support from engineering consultants is needed to ensure the application of appropriate technology to capital investments. The core competency of engineers working in the built environment is their ability to apply scientific and technical knowledge – mostly in a combined form of technical calculations and tacit knowledge of design based on extensive experience – to a project of construction (Baark 2004).

A gradual emergence of the general contractor as a distinct occupation began in the 18th century. During the 1700s, the roles of architects, builders and surveyors were loosely defined and often very similar. Builders understood and often practiced architecture; architects grew out of the building trades; and surveyors could draw plans for structures. In the 19th century, contracting organizations became larger and more complex organizations with subspecialties, usually in one or more of the building trades. The heads of these firms no longer practiced construction, but were instead organizers, managers and negotiators (Davis 2006). The cost of the construction contract is based on the A/E's (architect or engineer as lead design professional) design, usually under a fixed price or cost-plus-fee agreement between the constructor and the facility owner. The key to executing the construction contract is typically the talents of field supervision and coordination staff. Project superintendents, project managers and job foreman are told to get the job done at the lowest possible cost within a given budget of money and time, because a shorter project is a lower cost project due to the ongoing overhead costs of the construction firm (Kavanagh 1978).

Three aspects of building culture began to predominate by the late 19th and into the 20th century: First, a relationship between structures and machines became prevalent, as materials and equipment suppliers produced standardized products for site assembly (and facilities are often assembled, by hands and by machines, as much as they are constructed). Second, organization of site labor on large projects copied to some extent, the marshalling of military forces for deployment of an army. Former military officers, with engineering training, often went into construction after military service, and brought with them strategy, tactics, logistics, supply lines and critical path thinking. This formal procedural thinking became embedded in organizational approaches to most North American construction projects of any consequence. Third, the process of building (as well as the structures themselves) has not merely followed the evolution of society, but has influenced cultural development. The urge to organize and build is both personal and societal, and accompanies the human satisfaction of creating objects that are spatial, functional, circulatory and relatively permanent within the contexts of our lives (Peters 1996).

2.8 Linkage of Sector to the Built and Natural Environment, and to the Economy (Internal Motivations, External Influences, Sustainable Practices)

Buildings, civil infrastructure and industrial structures are built for the primary purposes of producing income or for long-term public investment. The 21st century economy continues with the financial goals of the 20th century, which are to maximize profit and wealth based on a view that commodities (including facilities) must be leveraged to their maximum extent to meet the exigencies of the financial system (Davis 2006). There is a growing realization, however, that there are three overriding economic challenges, all of which directly impact the built environment: challenges of allocation, distribution and scale (Daly 1996). The problem of allocation is one of deciding whether to devote resources to producing bicycles or beans; or buildings or battleships. An optimal allocation is one where people can get what they need and are willing to pay for through relative pricing that takes into account marginal opportunity costs.

The challenge of distribution is one of providing sufficient products and services to those that need these outputs. Public policy tries to even out the distribution through tax structure, availability of inexpensive alternatives (public housing units) and legal requirements for equal opportunities. The third challenge, that of scale, has been examined extensively but one for which we have no clear policy instrument (Fernandez-Solis 2006). The problem of scale cannot be addressed if one only looks to output measures and industry growth as partial solutions. Instead, substitution of different (and more environmentally benign) factor inputs and alterations in the transformational processes of design and construction promise some relief for closing the gap between projected need and industry capacity.

In *The Wealth of Nations,* Adam Smith asked why is it that water, which is so useful that life would be impossible without it, has such a low price, and diamonds, which for the most part are unnecessary, have such a high price. The answer, of course, is that diamonds are scarce, and the price of getting additional diamonds is high; and water is relatively abundant, and the price of obtaining additional liters or gallons is relatively low. Additionally, the total utility of water does not determine its demand or price, but rather its marginal utility – the price of the last little bit of water that people are free to buy or not to buy. With the theory of economic value, it is the tail that wags the dog. Air is a free good despite its vast usefulness because the many later units of the seemingly unceasing supply pull down the market value of all units (Samuelson 1976).

Firms within a capitalistic economy must pay attention to use value, because inputs of sufficient quantity must be accumulated, controlled and transformed into outputs that will sell at an adequate price (the price is typically determined from the cost of inputs plus production costs plus profit for reinvestment in the firm). Inputs into the production of goods or services must be used in a way that does not waste resources; otherwise the firm hurts its productivity or incurs additional costs in production. The concept of worth has at least two sides: the first of value in use, where the intrinsic characteristics of a product or service enable it to satisfy a human want or need; and the second of exchange value, wherein an independent money-value is placed on a good or service so that it can be traded in the marketplace as a commodity. The problem, stated simply, is that not every product (nor the collective consumption patterns of individual agents in an economy), is fairly priced at full use value. Full use value would include utility value plus psychological and environmental value to society. For example, a positive urban experience would include the commodity and exchange values of buildings, but also the use value of interconnecting streets, subsurface utilities, walkways and open spaces of a neighborhood would be added into the equation. An economic system that looks only at exchange value misses the manifold inputs comprising the fabric of a working city (or the multiple tangible and intangible assets of a well-functioning firm) – a conundrum that frustrate economists grappling with the concept of sustainability.

2.9 Design (Professional Services) and Construction Inputs, Transformational Processes and Products/Services Outputs for Buildings and Civil Infrastructure

The objective of this chapter has been to explore the context of knowledge-intensive and creativity-oriented firms operating in the marketplace, with particular attention to architecture, engineering and general contracting establishments within the professional design and construction sectors of the economy. Based upon the overview of these firms' operating tendencies, the degree to which the existence of the firms depends upon internal make or buy decisions, the extent to which external pressures such as economic and technological change stimulate adjustments by the firms, and an appraisal of how the firms are organized and structured, A/E/C firms can be categorized according to Thompson (1967) and Stabell and Fjeldstad (1998).

By the definitions provided in their peer-reviewed journal articles, both architectural and engineering firms are value shop establishments. The Nobel prize in economics was awarded to George Akerlof in 2001 for showing how the classic laws of the economic market do not apply when one party knows much more than another (where there are information asymmetries).

Unique asymmetric knowledge is at the heart of the A/E consulting business, where clients cannot possibly devote the time and attention to become specialists in architecture and engineering design and services (Fjeldstad and Andersen 2003). A major input to the process is the client's problem itself; as a primary activity, the A/E firm often conducts a process of problem identification, programming and value analysis on behalf of the customer. The production process, once the problem has been explicated, is to choose among alternative solutions and to implement the chosen alternative through a design. These activities are not usually sequential but involve cyclical and iterative approaches designed to help the client to move an existing state to a new desired state. Decisions about what projects the firm will take on is a senior professional function, not something normally given to a sales and marketing, and the project is chosen based on the billing of available professional personnel and whether the project will build the firm's reputation. The A/E value shop cultivates relationships with clients by investing in understanding their problems and finding ways to tailor the firm's specialized knowledge and skills to the problem at hand. Reputation of the firm gives access to the building blocks of competence: interesting but challenging problems and smart people who thrive on devising solutions (Fjeldstad and Andersen 2003). The key resource of a value shop is competence, and managing the value shop is about making sound choices about the resource level in the firm. Owners of a value shop amass a residual value with limited tangible or structural assets by understanding the motivations of knowledge-intensive employees, and working with them to build skills, experience and increased legitimacy (such as a defined career path and eventual stock ownership). The A/E value shop, configured to leverage expertise in an intensive fury in order to solve complex problems, engages multiple disciplines and specialties in spiraling activity cycles (Stabell and Fjeldstad 1998). There are five generic categories of value shop logic as applied to A/E firms, and each category is sub-dividable into separate activities:

1. Problem-Seeking – A client initiates a project and, usually based on a business case that establishes a statement of need, makes a decision to proceed with planning or design. A project programmer may assist in the development of scope and identification of background information, design criteria and performance requirements.
2. Alternatives Generation – Conceptual designs with options for scale and relationships may be generated at this stage, and competing facility sub-systems are considered for their applicability to the project. Evaluations of the alternatives are developed for presentation to the client.
3. Choosing the Preferred Solution – At this stage, the strength of skills and knowledge base of the A/E is the crux of the value proposition from the professional problem-solver to the customer. The value shop is a machine for understanding problems and mobilizing the resources necessary to solve unique,

complicated and important problems. It is a consulting studio that uses intensive technologies to ferret out a workable path toward a new aspiration.

4. Execution – For A/E firms, this phase often consists of producing design development and construction documents. From the customer's viewpoint, the architect or engineers role is to add value by using knowledge and expertise to transform capital resources into a new form of capital stock that has functional and exchange value. The reputation of the design professionals is the facility owner's insurance that the facility will be created with reasonable predictability of fitness for intended purpose.
5. Control and Evaluation – Deep knowledge of the design and construction process may influence the owner to sign an agreement with the A/E for construction observation, submittals checking, facility commissioning and other post-design services to ensure final product quality. The inspections, measurements and formal evaluations show to what extent the problem solution met the expectations of the initial problem statement.

A simplified model of transitioning from input needs to output deliverables during the A/E value shop production process would include: First, inputs of knowns, constraints, facility program and sound business case for proceeding with the project; Second, transformation of those inputs through thinking, dialogue, visualization, drawing, interactions with the client and other consultants, reconciling the client's agenda and budget with proposed solutions, and moving toward a preferred outcome based on pooled expertise and depth of understanding; and Third, generation of information such as designs, calculations, or professional advice suitable for the purpose of realizing the owner's goals, often through design, construction and testing.

Assigning a value logic category to construction or general contracting firms is not as straightforward as categorizing A/E design firms. A number of researchers have attempted to place construction within the category of a value chain. Among those who have tried to adapt the value chain model are Koskela (2000) and Howell (2000), albeit with overtones of lean production. Yet there are many aspects of intensive project-based work of construction firms, coupled with their one-on-one relationship made with owners through contract agreements that show construction as operating in a manner somewhat akin to a value shop. For this research, the classification of A/E/C firms according to Stabell-Fjeldstad model will be explored via questions posed to a Delphi expert panel.

The overall delivery of a construction project is largely concerned with transforming inputs into a functioning product. Interactivities within the delivery are, for the most past sequential and cost is a significant driver, leading construction firms to concentrate carefully on production rates and capacity utilization. This would unalterably lead the observer to designate a construction entity as a value chain organization. A facility is delivered through a construction process in a series of steps, including:

- Estimating costs for the project and submitting bids or proposals to the owner
- Contracting with the facility owner for work under the scope and requirements of the project, which is usually conveyed by facility drawings and specifications
- Preconstruction activities consisting of defining procedures, site access, shake out and other actions prior to start of the work
- Coordination of interrelationships among the parties including owner, owner representatives, users, designers, suppliers, etc.
- Coordinating and subcontracting with various subcontractors, suppliers and subconsultants to meet the requirements of the contract
- Installing mechanisms to manage time schedule, money flow, safety and quality of the work and project participants under control of the constructor
- Execution of the construction through management and manpower
- Closeout of the project and turnover to the owner/user

It can be inferred that Thompson could have observed construction sequencing and then have viewed the construction firm's approach as long-linked, where the company is managing products and equipment and transforming these components into a single functional product. To maintain a competitive advantage, this value chain organization tries to optimize component flow and product mix, watching for glitches in the value chain that could interrupt the logical sequence of activities, violating the strict schedule and costing the firm valuable time and money.

But this assignation of value chain to the construction organization would be too simplistic and partially inaccurate. Based on the construction firm's direct contractual relationship with the owner, and due to the special competencies that the constructor brings to the project-intensive work, one would observe that both the legal relationship (for the work) and the knowledge base necessary to provide unique means and methods for a long-lasting solution to the owner's problem (albeit based on a designer's advice), it would appear that some construction firms also function as a value shops. In chapter 4 of this research, assumptions about what specific asset groups and resource bundles are emphasized for value chains and value composite firms versus which asset groups and resource bundles are prevalent for pure value shops are explored.

"*If the foundations [of orthodox equilibrium economics] were empirically secure, the attention lavished on the ornate logical superstructure would be understandable. If the superstructure were austere and of immediate practical use, expedient commitments to shaky foundations might be justified. Increasingly, orthodoxy builds a rococo logical palace based on loose empirical sand*." __ Nelson and Winter, 1982

CHAPTER 3 THEORETICAL BACKGROUND FOR THE RESEARCH

3.1 Theory of the Firm

Much of classical macro-economics and management literature is concentrated on the workings and influences of markets and the overall economy, with sweeping attention to the ebbs and flows of commerce. Adam Smith in *Wealth of Nations* (1776), John Stuart Mill in *Principles of Political Economy* (1848), Karl Marx in *Das Kapital* (1867), Alfred Marshall in *Principles of Economics* (1890) and Thorstein Veblen in *The Theory of the Business Enterprise* (1904) theorized the forces of supply and demand, scarcity and abundance, production and consumption, and equilibrium and instability for national and international economies. It was not until after World War I that equal attention was given to the activities of firms, which became recognized by economists as microeconomic entities structured for various business purposes while operating within larger economic systems.

Among the questions that a "theory of the firm" attempts to postulate is the consideration of the very existence of firms, including why a company may arise and then operate within the larger market. Secondly, the theory of the firm attempts to address what extent of their activities are performed within the sphere of the firm and which activities are performed externally within the broader market, through processes that define their approximate boundaries. In addition, the theory attempts to show possibilities of why firms are organized and led in particular ways, such as the structure of large American corporations that is characterized by formalized business processes and hierarchical relationships for decision-making and operations.

Drawing on the earlier ideas of Veblen and Marshall, Ronald Coase explored the "The Nature of the Firm" (1937). A Coasian definition of the firm relies primarily on "substitution at the margin." Stated plainly, Coase agrees with Marshall that there is a fourth factor of production – that of organization. And the organization of production is overseen by the coordinating function of managers, which he cites as "islands of conscious power in this ocean of unconscious cooperation." The purpose of his theory, Coase claimed, was to bridge the gap between the assumption that resources were allocated by means of the price mechanism and newer suggestions that allocations were dependent on entrepreneurs and managers. Coase maintained that the main reason why it is profitable to establish a firm within an exchange economy is due to the costs of relying only on the price mechanism in the open market. The firm owner does not have to make a series of external contracts for factors of production and production processes when he has internalized some of these major transactions within direct control of the firm.

Coase postulated that the fundamental question for the existence and size of a firm was whether it would pay to bring exchange transactions under organizing authority. Business men will be constantly experimenting, controlling more or less, said Coase, while operating within a dynamic economy. He maintained that the effect of external factors on the cost of organizing the firm and on marketing costs explain why firms get larger or smaller. With his theory of "moving equilibrium," Coase also explained the relationship between entrepreneurship and management in the firm, showing how the former uses forecasting and price mechanism to forge new contracts and how the latter reacts to price changes, rearranging the factors of production under its control (Coase 1937).

3.2 Industrial Organization Theory

The primary institutions within an economy are business entities, government and labor (Samuelson 1976). There are over ten million business establishments in the United States, according to the Bureau of Economic Analysis. A business establishment as defined by the U.S. Department of Commerce is a business or industrial unit at a single location which produces or distributes goods or performs services. A company is a business organization consisting of all establishments under common ownership or control.

Theories of industrial organization began emerging as part of the discipline of microeconomics in the 1920s and 1930s. Industrial organization theorists are concerned with how firms are organized and how they compete within the regional, national and international economies. Among the topics examined by industrial organization researchers are perfect and imperfect competition, especially where industries have dominant oligopolies that may tend toward market and price signaling (or possible collusive activity), and those industries that have monopolistic private corporations or pubic authorities. Leading industrial organization theorists include Edward Chamberlin who wrote the *Theory of Monopolistic Competition* (1933) wherein he provided an outline for the interplay between corporate competition and customer choice, and coined the term "product differentiation." A contemporary of Chamberlin was Joan Robinson, who wrote *The Economics of Imperfect Competition* (1933) in which she suggests that the collective microeconomic actions of either producers or consumers can cause an economy to operate below its potential. But likely the most cited economist on industrial organization is Joe S. Bain, whose two books on the topic – *Barriers to New Competition* (1956) and *Industrial Organization* (1959) – investigate how new firms struggle to get established and existing firms often wrestle with expansion due to capital assembly requirements, product and product feature differentiation and due to price cutting by competitors to counter potential or actual loss in market share. Bain delineated the relationship between an industry's structure, conduct and performance through his in-depth research of California's energy companies.

A sweeping opus on America's contribution to organizational structure of firms was penned by Alfred Chandler in *The Visible Hand – Chapters in the American Industrial Enterprise* (1977). Chandler's thesis is that the growth of American railroads from the 1820s to the 1890s can be partially attributed to innovative organizational structures, new career functional and administrative managers and careful cost accounting for both operational and capital expenditures. In a companion work, Chandler makes a distinction between entrepreneurial decisions and actions and operating decisions and actions. The entrepreneurial actions, according to *Strategy and Structure*, refers to those that affect the allocation or reallocation of resources for the enterprise as a whole, whereas operating actions refer to those carried out by using resources already allocated (Chandler 1964). The two works constitute a multi-year chronicling of corporations making the transition from centralized and functionally departmentalized organizations to multi-divisional firm structures with product, market or geographic divisions.

In the second half of the 20th century, over-diversification caused executive management to become isolated from operating administrative management, causing an over-reliance on financial data and statistics at the expense of tighter working relationships and well-defined chain of command. This weakness in management strength caused many corporations to divest unprofitable or under-performing divisions and subsidiaries. On the other hand, restructuring sometimes went upstream to acquisitions rather than selling off portions of the enterprise, as companies sought to focus either on familiar core processes or continued with wide diversification, depending on their appetite for disparate technologies and their tolerance for risk. Within large American firms, due to both the quality of financial information and the ability of management to analyze the information, senior management began to lose the knack of examining the corporate patient and issuing a likely prognosis. This phenomenon is painstakingly dissected in Relevance Lost: The Rise and Fall of Managerial Accounting (Johnson and Kaplan 1987).

3.3 Theory of Accounting

The nature of financial accounting can be described as the process of identifying, measuring and communicating economic information to assist stakeholders in making informed judgments about the fiscal health and potential value of a business entity. Accounting practices for agricultural products began in Mesopotamia sometime before 3,000 BC (Giroux 1999). Modern accounting approaches are generally attributed to Luca Pacioli whose book on practical mathematics in 1494 suggested double entry bookkeeping to record business transactions (Gaffikin 2008). At the dawn of the industrial age in the late 18th century, Josiah Wedgewood organized detailed cost accounts to reveal the actual costs of chinaware and pottery production. Wedgewood's 1772 statement of "costings" not only listed every known cost for producing vases, but taught him about economies of scale, the importance of margins and the dishonesty of a few of his clerks (McKendrick 1970).

The proliferation of the railroad industry in the early 19th century gave rise to a number of new accounting problems. Large amounts of capital were required to construct the railways and purchase rolling stock, requiring issuance of shares and debentures for sale to multiple investors. Rail company accountants were faced with how to separate the capital expenditures from revenue expenditures, how to value fixed assets, the appropriate calculation of periodic profit and the form and content of financial statements published for investors, government and the public (Edwards 1985). By the 1830s, some rail companies were employing three types of statements: capital account, revenue account and general balance sheet. To place their railroad in a favorable financial light, rail companies were somewhat notorious in issuing a single financial statement that reflected positive financial standing at a specific stage in the railroad's development or operation. For example, the capital account statement would appear overwhelmingly rich after purchases of shares by investors and construction of right-of-way and track, but prior to purchase of rolling stock for operations. Similarly, a revenue statement would look positive ten years into operation at a time when the company sought to issue new shares for upgrading and expansion, however the capitalization of many fixed assets previously acquired or constructed would be conveniently omitted from the statement. Seeking to curb the abuses and to provide full disclosure to investors, the British government set out a form and content for accounting statements in 1868, with the objective being comparability and a facility for shareholders to see at-a-glance what was the exact financial position of each company (McKendrick 1985).

Measurement of assets by the Baltimore and Ohio Railroad in the 1830s included accounting treatment of equity capital and acknowledgement of depreciation of fixed and mobile assets. The decline of value of a capital good can be attributed to three factors.

First, the life expectancy of an asset retreats because it has fewer work years left as it ages. Second, it declines in physical productivity as time goes by due to wear and tear, and thirdly, it typically has a decrease in productivity in relation to the market as better machines and tools emerge. One can label these three major forces exhaustion, deterioration and obsolescence (Diewert 2006). For purposes of this paper, one might speculate that the value of tangible assets may be overstated in times of hyper-inflation (such as in Germany in the 1920s) and intangible assets may be accorded more value than readily verifiable in times of persistent deflation. But these are simply cautionary and advisory observations.

Accounting theory in the last quarter of the 20th century was bifurcated into two general schools of thought. The traditional normative accounting school, undoubtedly influenced by scholars working in microeconomics disciplines, strive to ascertain and then formalize optimal rules for financial and management accounting. Positive accounting theorists, on the other hand, followed on from the contractual view of the firm and attempted to explicate actual practice and make predictions of what may actually occur based on empirical studies. The Positivists were led by Watts and Zimmerman (1988) at the University of Rochester, who believed that accounting practice should regularly evolve to mitigate contracting and transaction costs between parties. The traditionalists, also known as supporters of the value relevance approach to accounting, argued that accounting's role is to value the firm and to provide shareholders information from which to form opinions on firm business activities, financial health and book value.

Accounting researchers acknowledge multiple theories beyond those held by positive and value relevance apostles. Behavioral accounting emphasizes the effects of people on accounting systems, and how systems can manipulate or influence people. Anthony defined accounting as a branch of operations control rather than of planning or organizational management (Anthony 1988). Simmonds, by contrast, emphasized the functionalistic imperatives of strategic management accounting (Simmonds 1981). Puxty points out the more recent use of the general systems perspective for accounting, with particular attention to contingency models (Puxty 1993).

A distinction can be drawn between theories of accounting and theories of *accounts.* Since the 1940s in France and the 1950s in the United States, government economists have been working on systems of national accounts. National accounting aims to establish descriptive models of the economy as a whole. But just as Keynesian economics fell out of favor in the 1970s and 1980s, so followed the partial demise of the notion of national accounting, which some damned during this period as “social accounting” (Vanoli 2005). Defenders of national accounting maintained that attempts at measuring and estimating each country’s assets and liabilities, along with analyses of financial flows and discussions of the importance of factor inputs for production and productivity, were sufficient reasons for continuing the pursuit of economy-wide statistics based on national accounts. Further, these proponents argued, the use of accounting for firms and other entities at the microeconomic level could be harmonized to some degree with national macroeconomics, so that statistically based research could be scaled up or down as needed by economic scholars (Vanoli 2005).

Samuelson reminds us that nothing in economics and finance can be measured with the great accuracy of the physical sciences. Approximate measurement has to suffice, as long as the methods of measurement remain relatively constant over time (Samuelson 1976). Balance sheets and their line-by-line accounts depend on the valuation of assets, but assets are subjected to changing price levels due to supply and demand, plus inflation and deflation, appreciation and depreciation. As an example, selling off of older assets at less than replacement cost can have a deleterious effect on the continuation of current business, because the worn-out machines and factory buildings cannot be reproduced without infusions of additional capital from other internal or external sources.

Financial management and corporate accounting researchers recognize two themes for hypothetical exploration within the theory of accounts. The first relates to traditional accounting and its replicable nature, which lends itself to computer modeling and testing of large amounts of financial data. A starting point for what has been termed *matrix accounting* (named after matrix algebra) are the papers of Mattessich, Ijiri and later Shank, who pioneered the use of computerized spreadsheets and mathematical analysis for keeping track of accounts over long periods of time (Degos 2006). A later variation deriving from matrix accounting is *events theory*, enabling the user to extract specific data from entity specific relationships and to use it to compare and contrast multiple entities (Degos and Mattessich 2006). A second theme relates to valuation of firms, industries and national economies, which has been pursued more consistently by experts in management and public policy. Vanoli hints that the estimate of the value of today's capital stock and capital services is the present value of all future production and consumption possibilities (Vanoli 2005). That is to say, there is a probable link between existing accumulation of stocks, capital formation for a specific productive purpose, and investors' valuation of assets in terms of how they expect the entity to perform, given internal capabilities and external uncertainties. It is upon a combination of the resource-based theory, coupled with the valuation theory of accounts, that this thesis acknowledges as essential buildings blocks toward a more complete *tableau de bord* of a firm.

3.4 Transaction-Based Theory

Transaction cost economics is often used to explain the fundamental reason for a firm to exist; that is, why some transactions are done in the open market and some are undertaken by managers within a firm structure. More to the point, transaction based theory tries to describe why a firm may be structured in a particular way and whether the firm leans more toward vertical integration or toward dependence on the market for needed factors. Ronald Coase noted that as the transactions which are organized increase, the entrepreneur may fail to place the factors of production where there value is the greatest; or stated another way, a larger firm is able to internalize and control more transactions, rather than relying on the open market (Garrouste and Saussier 2005). A firm of sufficient size is also in the position of exercising better coordination of transactions that are made outside of the firm boundary.

The existence of the firm is explainable in terms of incentive problems that arise when production of the firm is combined with asymmetrical information and opportunistic proclivities of individuals. Because some workers exhibit lower than necessary productivity and these costs are not transferred back to the less-than-productive employees, the firm sets up monitoring systems to confront the issues. Team-production, incentives and other institutional structures can lead to vertical integration as firms try to avoid the costs of external contracts and metering at each stage in the value chain (Alchian and Demsetz 1972).

Ultimately, the prescription from transaction cost economic theory is that firms should internalize transactions when contractual hazards are present and favor the market when such hazards are absent (Mayer and Salomon 2006). In order to carry out a market transaction it is necessary to decide who one wants to deal with, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure the terms of the contract are being observed, and so on (Coase 1937). Stated directly, transaction costs consist of three major areas: search and information costs, bargaining an decision costs, and policing and enforcement costs (Watkins 2006). The extent of contractual hazards that may be confronted by a firm are present due to asset specificity. Asset specificity refers to the transferability of assets to alternative uses. When assets are specific to certain types of transactions, they have little value outside of the firm context. If the specialized production process requires dedicated assets, suppliers may take advantage of the opportunity to "extract excessive rents" from the customer (Mayer and Salomon 2006).

An important distinction in contracting is the difference between instant transactions and deferred transactions. Instant transactions are those that occur immediately after selection by the buyer, such as purchases in a grocery store or buying of fuel at a gasoline station. Deferred transactions involve the exchange of promises, where the seller asks for some consideration now for the delivery of future goods and services. The seller wants enforceability of the contract to induce the buyer to make the purchase, and the buyer wants enforceability as an incentive for the seller to perform and as a remedy in case of the seller's breach. The longer the time between the contract (initial transaction) and the actual performance of the terms of the agreement, the greater the opportunity for uncertainty, risk and incomplete performance. A recurring problem with transactions and contracts is the degree to which one party has more information about some aspects of the agreement and the second party has less. Sometimes not all facts are transmitted, and sometimes, even if all facts are conveyed, the other party does not understand the information (Coofer and Ulen 2002). For example, in the design and construction industry, division of transactions into various phases, such as planning, design, construction and operations, places information at different times in the hands of individuals with different vocabularies and skills and motivations. Some transactional economics theorists would argue that such asymmetric information and alternative industry approaches would result in serious obstacles to optimal contracting.

The modern oracle of transaction theory, Oliver Williamson, maintains that all complex contracts are unavoidably incomplete, and the parties to these contracts will be confronted with the need to adapt to unanticipated disturbances that arise by reason of gaps, errors and omissions in the original agreement between the parties. The major importance of a legal contract is to provide a framework, which never accurately indicates real working relations, but provides a rough indication around which such relations function, plus a partial guide in cases of doubt. But these incomplete and worrisome contracts are sometimes still preferable to unified ownership of all means of production. Added bureaucratic costs accrue upon taking a transaction out of the market and organizing it internally. Internal organization to handle most transactions is sometimes thought of as the organizational form of last resort: try markets, try hybrids and have recourse to the firm only when all else fails (Williamson 2002).

Some researchers are careful to point out the differences between industries that produce identical goods and industries that work on unique projects. The production of identical goods will likely involve a series of repeated exchanges with the same or similar market providers and the same internal sources to assemble the factors of production for those repetitive goods. The customized nature of service projects, whether in engineering design for facilities or software for firm operations, indicates that each project will be a separate, and to a large degree, dissimilar transaction from the previous one. Sourcing decisions require the evaluation of the attributes of each alternative, and some decisions are likely to be made on reliability, trustworthiness and long-standing relationships rather than on dispassionate price and risk calculations (Mayer and Solomon 2006).

Transactions often involve the sale or exchange of economic assets, which are used as stores of value until such time as corporate assets are used as factors of production or sold. Who has the rights to receive the benefits flowing from an asset? Those who have legal title to assets, whether they are sole holders of all rights belonging to the resource or are simply renting the asset on a short-term basis in order to exact some use from the asset's attributes. A property right is a formal recognition by law or society that conveys an exclusive right on an owner or group of owners, and can exclude others from making use of the asset (Youngman 2003). In an economy with a strong operating legal system, firms will have very few obstacles in exercising property rights over tangible property, including machines, equipment and physical property (Mahoney et al 2004). But in order to make progress on the management theory of the firm, an understanding of the property rights of all stakeholders (including those with residual rights, such as employees) should be added to the equation. To make progress in understanding the conduct of firm business in light of all asset classes, the researcher would want to take into consideration explicit contracts and economic transactions as well as implicit contracts and non-transaction-based changes in economic value of a firm's assets.

Transaction cost economists concur with Herbert Simon that the cognitive and self-interest attributes of human actors affect the performance of the firm. Due to bounded rationality and opportunism, there is a tendency to evaluate their actions in terms of sub-goals (Simon 1958). Under the behavioral approach, decisions made within the firm are based on the expectation that individuals "satisfice" rather than attempt to maximize a utility or profit function on behalf of the firm. Compared to an idealistic state of maximum efficiency, there is organizational slack and these under-performing workers are deemed to be *shirkers*. Neoclassical economists have made the assumption that workers prefer leisure to productive work, and therefore need monitoring or at least incentives to maintain acceptable effort on behalf of the organization. Recent studies have showed that firms having objectively-measured and realistic performance goals and/or an organizational "culture of effort" rarely have any widespread problems in this regard (Minker 2001).

3.5 Resource-Based Theory of the Firm

The fundamental principle of the resource-based view of the firm is that the basis for competitive advantage is the bundle of valuable assets at the firm's disposal. These resources may hold the keys to short-run competitive advantage or long-term sustained competitive advantage depending upon their coordination and deployment in combination with internal and external factors. Firm resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge and other factors controlled by the firm (Barney 1991). Strategic management research attempts to provide explanations as to why some firms are more successful than others, recognizing that the expectation for success may be borne out by the realization of quarterly profits for firm shareholders and its board of directors, or as Chandler identified in *The Visible Hand*, success may be defined as multi-year sustainability by key managerial employees, whose organizational self-interest is played out through managerial decisions designed to maintain the long-term health of their employer (Chandler 1977).

Resource-based theory shifts the focus from building market power via manipulation of industry structure and combinations of products for intended markets to leveraging internal resources that can be used efficiently and effectively to gain economic advantage (Galbreath 2004). Resources possessing specific characteristics are primary determinants of firm success, and these resources should be heterogeneous in nature and not perfectly mobile. Barney's prescription for implementing resource-based theory is to first identify the firm's key resources, and then to evaluate whether the resources possess the following attributes: 1) valuable – can the resource either help the firm in outperforming its competitors or reduce the effect of firm weaknesses; 2) rare – the availability and price of the resource to the firm must be attractive as compared to the availability and price of the resource to others in the market; 3) In-Imitable – where one firm controls a valuable resource or at least is in a position where other competitors cannot duplicate the strategic asset perfectly; and 4) non-substitutable – competitors are not able to counter the firm's value creating strategy with a substitute (Barney 1991).

Within the resource-based view, economies of scale in production, research and development, resource base, etc. are essential and hence larger firms have the ability to dominate. But small firms have greater flexibility and are seen to occupy niches or interstices alongside their larger counterparts (Lockett 2005). Larger firms (presumably, firms with years of experience also) may have a comparative advantage based on the resource bundle that they possess or control, but the position of advantage can be eroded over time. Therefore, these firms need to expend some time and effort on the creation of new advantages or face loss of their competitive position due to positional inaction.

Not all of the resources in the competitive bundle need to be traditional fixed and financial capital. Among a handful of chosen resources, Penrose pinpoints endogenous services, technological bases and firm competencies in her *Theory of the Growth of the Firm* (Penrose 1959). The uniqueness of a firm's resource base (and the source of its competitive advantage) makes testing of the theory difficult, but specific elements can be tested, such as patterns of diversification, blends of factors of production (plus management techniques), corporate refocusing, and selective divestment. Another issue confronted by resource based theorists was whether management role should place greater emphasis upon sustaining competitive advantage or on creating competitive advantage in the first place. Some have carried this notion further and suggested that some firms concentrate more on maximization, thereby gaining competitive advantage and returns on assets, and other firms on optimization, thereby making best use of tangible and intangible resources over time (Galbreath 2004).

Similarly, not all resources contribute equally to firm success (Barney 1991; Peteraf 1993). Resource-based studies tend to be idiosyncratic in that they operationalize a single resource or a limited number of resources to fit the study, and exclude other resources that could be important to competitive advantage. These studies may be overestimating the impact of a few resources and undermining the complexities of competitive advantage (Galbreath

2004). For example, technology has been a perpetual source of economic growth, innovation and competitive differentiation. However, the rapid introduction of new technologies in the information age, in ways that alter both industry production and external markets on a massive scale, changes the nature of commodities and services development as well as working environments, consumption patterns and communication networks. The resulting confluence of change lowers transaction costs, reduces barriers to entry and blurs traditional industry boundaries (Hitt 1997).

Mintzberg attributes an important postulate about firm strategy to the "design school," which says the firm fit between internal capabilities and external opportunities determines competitive advantage (Mintzberg 1990). Other Canadian scholars have looked at both sides of firm performance, and have contrasted competitive advantage and market success to lack of advantage and firm failure. For any given firm, failure is the result of insufficient rent generation from its bundle of resources. The major problem facing smaller and younger organizations is survival, whereas larger and older organizations face the problem of strategic transformation. Whether an organization ages well or badly often depends on whether the rate of adaptation allows increased (positive) competence or increased (negative) rigidity. In some instances, managers simply do not or can not acknowledge that previously successful strategic postures have become uncompetitive (Thornhill and Amit 2003).

Resource-based theory relies on an assumption that firms gravitate toward growth by utilizing all of the firm's available resources. Entrepreneurs are challenged to face the reality that there are unproductive resources within the firm that have yet to be transformed into profit-generating activities. Firms are confronted by turbulence in the changing economic environment, and can benefit from knowing how to flexibility respond to the external forces with mobilization of unproductive or underperforming resources (Anantadjaya 2008). The resource-based theory has been bolstered by studies showing that firm-specific factors are more important than environmental or industry-structure characteristics in explaining superior performance (Olavarrieta 1997). Firms are bundles of resources consisting of three categories: first, input factors are generic resources that can be acquired by the firm from the market (usually by purchase); second, assets are stocks of available factors that are already owned or controlled within the firm, and are accumulated over time through firm operations, usually through financial transactions or investments; and third, capabilities are complex bundles of individual skills, assets and accumulated knowledge, such as the ability to work in teams, to manage supplier relationships and to build new technological capabilities (Olavarrieta 1997).

Resources are important to the firm strategically as it plans for future markets or growth as well as for the economic rents that resources can generate. These rents are defined as the excess return to a resource over the opportunity cost, or payments received above and beyond the amounts necessary to retain or to call the resource into use (Peteraf 1993). Firms that ascribe to the resource-based theory are rent-seekers rather than profit maximizers, and there is an incessant quest to find new competitive advantages to sustain existing market share (Teece 1997). Distinctive resources, especially when they are capabilities resources, cannot remain so forever. Innovation, imitation and learning by competitors may cause once-distinctive resources to become commonplace or even obsolete. To be successful under this theory, firms must concentrate on the acquisition and development of those resources that are scarce, hard-to-imitate and valuable to their customers now and in the future (Olavarrieta and Ellinger 1997).

Industries are populated by firms that perform differently from one another. This suggests that the marketplace is comprised of heterogeneous firms that are different because 1) they know how to do different things even if they are producing the same kinds of products or services; 2) they have been fortunate to develop superior techniques or approaches; or 3) because they have different capabilities, which they can identify and protect (Lewin and Phelan 1999). These new capital combinations, consisting of input factors and other resources, are relatively easy to count in terms of dollars, or in ratios calculating the relative contribution of inputs to output of products and services. The difficulty is to ascertain the relative contributions of factors to firm longevity. There undoubtedly is a difference in asset valuation when one views resources through these two prisms. The resource-based theory appears to strike a better balance between near-term profitability and net asset growth versus long-term survivability and holistic asset expansion.

3.6 Production and Input-Output Theory of the Firm

The production process employs resources and factor inputs to create commodities or services that are used in the exchange economy. Production, defined broadly, can include all phases of asset acquisition, manufacturing, inventory storage, packaging and distribution. Only the final purchase (consumption) is excluded from the production/conversion process. Resource inputs, or factors of production, usually consist of raw materials, machinery, labor, capital, land and entrepreneurial/management services. Samuelson contends that the demand for productive factors is actually a derived demand; that is, the demand is driven by the firm's factor input needs that are in turn driven by consumer demand for the product or service (Samuelson 1976).

Production theory, simply stated, is an expression of the long-familiar idea that if the input quantities vary, the output quantity will vary as well and in certain characteristic ways. The major uses of the theory are for analyzing the role of production possibilities in the determination of relative prices and in the efficient allocation of available resources (Winter 1982). Classical economics asks "how much will output increase if the amount of this particular input is increased, if all other inputs are held constant?" Recently, some economists have also been asking, "How much output can be obtained, given a list of specific inputs, to obtain the maximum production?" Production measures of the macro-economy are key inputs into the daily capital allocation decisions made around the world by central banks, companies and individuals. Production data can be used for forecasting the economy's potential for growth, adjusting monetary policy and understanding the tradeoffs between inflation and "full" employment. A micro-economic production process is a flow concept that is measured as a rate of output per period of time, and is efficient if a given quantity of outputs cannot be produced with any less inputs (Youngman 2003). A quantity of a fixed factor of production cannot readily be changed, such as a large machine, a factory assembly line and building, or key experienced management personnel. A variable factor of production, on the other hand, can be readily changed within the production process. Variable inputs include most raw materials, energy consumption and transportation/distribution services.

Table 3 Evolution of General Asset Classes

Evolution of General Asset Classes

1770 to 1920	1920 to 1980	1980 to present
EARLY INDUSTRIALISTS' ASSET POOL	BASIC AND SERVICE INDUSTRIES ASSET POOL	POST-INDUSTRIALISTS' ASSET POOL – the five M's
Land Labor Capital	Land Labor Capital + Management	Machines Money Minds Motivation + Milieu (Environment)

The principle of diminishing marginal returns to a variable input suggests that as you add more and more of a variable input, you reach a point beyond which the resulting increase in output starts to diminish. A short run production function is expressed by the amount of output relative to the amount of variable input while fixed inputs are held constant. If all inputs are varied, then a curve can be drawn that depicts a long run production function. Production of outputs can be achieved in multiple ways, but a simpler method has been devised wherein two inputs can be compared using an isoquant, expressed as a curve that shows all the ways of combining two inputs as to produce a given level of output. Most analyses of the so-called new economy use a framework of multi-factor inputs that incorporate indices of input volume by sector (Moulton 2003).

As mentioned earlier, a production process is deemed efficient is a specific quantity of outputs cannot be produced with any less given inputs. The process is inefficient of there exists another process by which the producer could create the same output by using less inputs. In the long run, all factors of production (inputs) could be adjusted by the firm and therefore be deemed variable inputs; however, in the short run, at least some of the inputs are fixed. A fixed factor of production in the short run is defined as one that could not readily be changed in quantity or quality, such as sizable machine tools, factory buildings or even key managerial personnel. Also noted earlier was the principle of diminishing marginal returns to variable input. This concept assumes that as you add more and more of a variable input (fixed inputs being held constant), they one will reach a point at which the resulting increases in output start to diminish. Resource allocations and efficiencies in production vary widely by industry due to differences in technologies and in mixes of capital and labor investment. Governments assess industry production in three ways: input measures, output measures and input-output or throughput measures (Berndt and Triplett 1990).

Commonly measured input models incorporate labor hours and tangible commodities such as raw materials and intermediate goods. Most output models rely on aggregates of current-dollar values of shipments, usually gathered from some industry source. As examples, drug production statistics are acquired from the Pharmaceutical Manufacturers Association; gas production from the American Gas Association; and bed and futon manufacturing statistics from the American Sleep Products Association. The current measures continue a bias for physical goods as the main source of value, with a strong industrial focus on mass produced products and mechanical technologies. There is a corollary bias for measurement of inputs or outputs, when the most clarifying data would result from processes linking input and outputs for basic and service industries (Youngman 2003). In reality, the mathematics of input-output economics is straightforward, but the data requirements are overwhelming, because many sectors of industry have ready access to only partial input or output data, and even when it is compiled for an industry, the resulting measures are months or years out-of-date.

A separate problem with production theory arises with the considerable differences between the production and distribution of tangible goods and intangible goods and services. The output of services (including most design and construction services) is produced and delivered under constraints that are not encountered in goods output. Goods can be consumed or used long after they are produced at locations that are remote from their place of production. The separation of distribution and use from production is not feasible for many services. Services cannot be produced without the agreement, cooperation and in many instances, the active participation, of the consuming entities. The services are not inventoried – that is, one would not maintain a storehouse of appendectomies at the hospital nor a hangar full of passenger miles at the airport. The impossibility of putting services into stocks makes them incapable of being traded independently of their production and consumption (Hill 1997). The nature of service outputs and the distinctive production processes of service establishments (when compared to extraction and manufacturing industries) make a strong case for alternative theories of production.

Before Porter developed his notion of the value chain, Thompson proposed a typology of firm functions divided into long-linked, intensive and mediating technologies. He discussed how the value creation process depends on communication and coordination between activities, and designated these interdependencies as sequential, reciprocal or pooled (Thompson 1967). The value chain activities of production include inbound logistics, operations, outbound logistics, marketing and sales and lastly, servicing of the product in the hands of the buyer. The value chain concept is not meant to mirror the steps of production, but is used to identify strategic improvement needs or opportunities. Support activities to the primary activities of the value chain include procurement, technology development, human resource management, and firm infrastructure (such as general management, planning, finance, accounting) that help determine the firm's cost position (Porter 1985).

Building on the seminal works of Thompson and Porter, two researchers from the Norwegian School of Management have proposed three generic value models to characterize firms. Porter's value chain has been an excellent model for describing and analyzing manufacturing companies, but it fell short when analysts attempted to apply the model to service-oriented businesses. *Value chain* approaches are ideal for looking at production enterprises where the emphasis is on selling as many products at the highest possible margins to the appropriate customer segment (Fjeldstad and Andersen 2003). A high-performing value chain company tries to strike a balance between cost and differentiation in its production and market alignments. A position of competitive advantage is not chosen by these firms directly, but rather must be attained by adjusting scope and by modifications to cost and value of the product mix (Stabell and Fjeldstad 1998).

After accepting the value chain model as an accurate description for the workings of manufacturing and extraction industries, the Norwegians then identified two models for the remaining two-thirds of firms found in modern economies, which are, of course, predominately service firms. The *value shop* uses its resources and technology to solve a customer's problem. Examples of value shops are professional service firms, as found in law, management consulting, medicine, pharmaceutical research, architecture and engineering. A customer problem can be defined as the difference between an existing state and a new aspired state, and the value shop's obvious value proposition is helping the firm move to this new state. There usually exists a strong information asymmetry between the customer and the firm, such as when a doctor knows the appropriate treatment or cure for an illness. The value shop is normally configured to deal with unique problems, clients or projects, rather than having a standardized solution that would fit most customers. The flow of activities is not linear (as in value chain) but iterative and cyclical between specialist and client (Stabell and Fjeldstad 1998). Firms that can be modeled as value shops are typically populated by experts and professionals in the problem domain covered by the firm (Abbott 1988). Clients of value shops are primarily looking for relatively certain solutions to their problems, and not for services that have low prices as their chief attribute. For the suppliers of value shop services, professional time is the key determinant of cost, although the value of solution could have a separate and somewhat different valuation. Difficult projects and demanding clients provide a basis for effective learning, and can strategically position the value shop firm for future work (Stabell and Fjeldstad 1998).

The *value network* is a third type of value model, which facilitates relationships among customers who are widely distributed in time and space. Examples of value networks are telephone and telecommunications companies, retail banks, member-based non-profit associations, insurance companies and postal services. Managing a value network is like managing a club – the organization admits members that complement each other, and occasionally exclude those that don't. Supplier-consumer relationships exist among members, such as in a bank where some are lenders and some are borrowers. Value is derived from service, service capacity and service opportunity. Value networks manage customer communities as opposed to customer segments (as a value chain would). A community is a group of people who have something that they do, or want to do, together through patterns of interaction rather than demographic sameness. Managers must manage the revenue yield of the whole network, not the individual connections, so the metaphor is managing forest rather than tree profitability. A former British Airways CIO said that BA almost went bankrupt selling products called flights, until they learned that a flight was simply a way to feed the whole network (Fjeldstad and Andersen 2003). The airlines call it system yield management, but the concept works for all types of value network companies.

This research builds upon value chain theory and its antecendents (i.e., value shop, value network or a hybrid of the three) by incorporating the typology, expanding the explicit application of the value-add classifications to A/E/C firms, suggesting variants and hybrids beyond the typology and (taking a risk by truly embracing interdisciplinary study) proposing a furtherance of resource-based theory that reconciles that economic and competence-based theories of the firm with varying repositories of static, dynamic and knowledge assets.

3.7 Theory of Strategic Planning for the Firm

A pioneering concept of strategy was developed by Ansoff in the 1960s to suggest to firms 1) how to identify what business is appropriate for their asset base, 2) what guidelines to follow to search for strategic opportunities and 3) how to use decision tools to narrow selection of goals down to the most attractive options. Fifteen years before Porter's "Competitive Forces" approach, Ansoff published *Corporate Strategy* in an attempt to answer whether firms should diversify, and if so how vigorously. He warned that strategic decisions were made within the practical framework of limited total resources, and said that the organizational objective should be to develop resource allocation patterns that rationalize make or buy decisions. Ansoff was convinced that organizations linking related products and markets were likely to be more successful than conglomerates with unrelated products and markets (Ansoff 1969).

During the 1980s, the predominate theory of strategy was tied to Porter's competitive forces framework. In this model, five industry forces – 1) entry barriers, 2) threat of substitution, 3) bargaining power of buyers, 4) bargaining power of suppliers, and 5) rivalry among industry incumbents – determine the competitive advantage and profit potential among rival industry players (Porter 1980). In one of his books, Porter emphasized the value of conducting a competitor analysis, including trying to understand future goals of the competitor, the competitor's assumptions about itself and its industry, the competitor's strengths and weaknesses and the competitor's current strategy (how it is currently competing in the marketplace. Among the questions Porter posits are: Where is the competitor vulnerable and what moves would provoke the most effective retaliation by the competitor. Other authors have further explored the comprehensive competitor analysis approach in what has become known as the strategic conflict school.

The strategic conflict school suggests the use of game theory to analyze degrees of cooperation and conflict. Gaming theory can reveal strategies to help firms exploit market power and it formalizes aggressive Machiavellian moves like predatory pricing, patent races, asymmetric business moves and countermoves (Myerson et al 1997). Strategic conflict theory has been criticized for over-reliance on large mathematical models dependent on copious data, lending itself to "garbage in – garbage out" accusations. Teece also has a sharp critique for game theory combined with business strategy, arguing that it is steeped in the "do unto others before they do unto you" military offensive mindset that ignores the more enduring sources of competitive advantage such as development, combination and protection of unique skills and capabilities (Teece et al 1997).

Mintzberg traces the trajectory of strategic planning in his tongue-in-check *The Rise and Fall of Strategic Planning*, attributing part of the “fall” to McNamara’s dogmatic application of the Planning-Programming-Budgeting-System in the US Government. Wildavsky summarized the 1970s experience as a failure “everywhere and at all times” (Mintzberg 1994). What the federal government sought to implement was a vast system of strategic analysis, planning decision-making and budgeting into on unified structure of information. The machinery and the processes to do the job forced all concerned to pay attention to the machinery and processes to do the job. The fatal flaw of the PPBS system, said Summers, was the imposed consistency of the rationalist model (Summers 1981). The military found themselves designing weapons on abstract criteria, carrying out strategies in which they did not believe and ultimately conducting a war [Vietnam conflict] that they did not understand (Kissinger 2003). To paraphrase Clausewitz, policy procedures that are essentially economic direct the activities toward physical quantities, whereas all military action is intertwined with psychological forces and effects, namely will and commitment (Mintzberg 1994).

An offshoot of strategic planning theory emerged in the 1980s after an experience at Royal Dutch Shell that led to scenario planning as a tool to expand beyond traditional planning. The scenarios were configured not so much as to predict various outcomes as to try to understand the forces that would compel a given outcome (Wack 1985). But how many scenarios should be drawn? Some said that three may be too few to capture the numerous possible outcomes, but an infinite number would likewise be unmanageable. Porter recommended limiting the number of possible scenarios to five, and scenario planners examining the future of South Africa during apartheid looked at four. Three of the four would have been disastrous for the country, and there was a great deal of behind-the-scenes work to avoid the consequences of the three “bad” scenarios and a massive effort to make the “good” fourth scenario a self-fulfilling prophecy (Schwartz 1991).

Mintzberg suggests that planning and strategy need to be tailored to different types of organizations, and his framework includes five types:

- Machine Organization – is a classic bureaucracy that is highly formalized and centralized. It is located within stable, mature industries such as commodities manufacturing or traditional banking.
- Entrepreneurial Organization – is a fairly simple flexible structure closely controlled by the chief executive and directly supervises operations and people, such as in small business start-ups or turnaround situations.
- Professional Organization – carries out expert work in a relatively stable setting, and may be found in administrative hierarchies such as hospitals, universities and other organizations where professional, skilled and craft services predominate.
- Adhocracy Organization – carries out expert work in highly dynamic settings, where experts work cooperatively in project teams. Often a matrix structure with projects and line functions, such as in filmmaking and aerospace industries.
- Diversified Organization – Organizations split into semiautonomous divisions to serve a diversity of markets, with headquarters relying on economic services and financial control systems to standardize the companies (Mintzberg 1979).

Regardless of the planning flavor adapted by the five types of organizations, Mintzberg cautions that formalized planning is helpful only in relatively stable environment. When the economic environment is unstable or dynamic, more flexible forms of strategy-making and implementation must be employed. Firms plan because they need to assure themselves and other stakeholders (e.g., boards, employees) that they have taken the future into account. The reason for looking at the future in a systematic way is to understand the future implications of present decisions (Loasby 1967). Ansoff provided two concepts for planning and strategy-making in a changing environment not mentioned earlier. First, gap analysis is a way of comparing the current position of the firm to a proposed course of action. If the proposed course, when tested or examined, does not substantially close the gap, then the strategy should be reviewed for shortcomings or better options. Second, synergy is a name for fit or congruence of components to gain competitive advantage. It tries to encompass combined or cooperative action that produce a return on the firm's resources greater than the sum of its parts or based on Ansoff's math, a "2 + 2 = 5" effect (Ansoff 1969). Out of this concept grew the construction of company capability profiles and strengths/weaknesses analyses as ways to reconfigure the firm's product/market approach.

The resource-based approach to strategy sees firms with superior systems and structures as being profitable not because they make strategic investments that deter entry or maximize prices above long-run costs, but because they have markedly lower cost structures or offer markedly higher quality or product performance (Teece et al 1997). Under this sub-theory, firms are heterogenous with regards to their resource endowments and capabilities. And they are "stuck" with the resource base they have because firms lack the organizational capacity to develop new competencies quickly and some of these (competence) assets are not readily tradable (Dierickx and Cool 1989). However, winners in the global marketplace have been firms that can demonstrate timely responsiveness and rapid, flexible product innovation, coupled with management capability to effectively coordinate and redeploy internal and external competencies. Specifically, the firm needs *dynamic capabilities* for timely deployment and strategic innovation (Teece 1997).

The strategic advantage of the firm is at least partially dependent on its managerial and organizational processes, shaped by its specific asset position and the paths available to it (Teece 1997). In a rapidly changing business environment, there is great value in the ability to reconfigure the firm's asset and resource structure to accomplish an internal and external transformation (Langlois 1994). Path dependency of a firm is tied to the firm's current position and paths ahead based on its trajectory. Because history of a firm matters, anti-ossification tools such as strategic focus, analysis and implementation abilities can help prevent the brittleness that comes with aging firms. Otherwise, firms are stay true to their existing repertoire of routines (a major part of the firm's history) and are locked in by the firm's internal gyroscope. This path dependency constrains the firm's future options when the routines lose their value to support a product or service no longer of value to the marketplace or if the routines can be easily replicated or emulated by competitors (Teece et al 1997).

3.8 Evolutionary Theory of the Firm

After Charles Darwin developed a biological framework explaining how a series of small incremental changes over time can accumulate into a completely new form or sub-species, evolutionary economics theory emerged to explain how economic processes undergoing mutations over time can transform societies, industries, firms and individual consumers. Thorstein Veblen was one of the economists who built upon the evolutionary idea, adding the notion that cultural influence played an equal role in socio-economic life as technological dependence, and seeing the two as contrary or opposing forces. Veblen termed his observation the "ceremonial/instrumental dichotomy," where cultural patterns of group behavior are played out against tools, skills and resources necessary to support organized society (Veblen 1904).

Joseph Schumpeter is regarded as the leading progenitor of evolutionary economics. Schumpeter disagreed with the theoretical basis for ongoing macroeconomic equilibrium, as advanced by John Maynard Keynes and David Ricardo. Instead, he suggested that the economy's supposed steady state is constantly being destroyed by entrepreneurs who bring forth innovations that introduce substantial price reductions for current products and services, or create new products and services that render existing ones obsolete. This "creative destruction" allows capitalism to renew itself, rather than meeting the business cycle-induced demise as had been predicted by Karl Marx (Schumpeter 1934).

A critique of neoclassical production theory is offered by Nelson and Winter, who maintain that production theory starts by stating that all firms can operate available and technologically feasible technologies. Technical knowledge, then, would be universally available and exploitable because it is exogenous and can be written down in a manual, a graphic design or in computer data. Instead, Nelson and Winter emphasize firm differences, based on different capabilities, different organizational structures and different knowledge bases as the fundamental elements of evolutionary theory (Nelson and Winter 1982). The organization can use routines to transform conflict into cooperation by encouraging reciprocal altruism, discouraging free riding behavior and using repetition to inculcate behaviors (March and Simon 1993).

Principal-agent models of the firm (also from neo-classical economics) basically reduce the coordination function of the firm to a bundle of bilateral contracts, where the agreements are designed to achieve inter-firm coordination by use of incentive schemes in order to direct or re-direct self-interested individual action toward a common organizational goal. The incentives are used to cope with asymmetries of information, because individuals are self-seeking and sometimes prone to shirking or cheating (Cohendet and Llerena 1998). But a complementary view of the firm looks more toward organizational structure and processes, and focuses on the bounded rationality of individuals who are employed by the firm. Here, agents try, in good faith, to advance the organization's objective goals, with recognition that payoffs depend on the actions of compatriots.

Cohendet and Llerena propose a new definition of evolutionary theory that explains the structure and behavior of a firm as an emergent property of the dynamics of interactions both of its constituent parts (internal) and of the firm with its environment (external). The dynamic interactions are applied routines based on interpretations of past knowledge and current productive activities. Routines have a strong cohesive function: they typically survive the replacement of people who created them, and they keep the organization together by conferring on it a uniqueness that is partly independent from the individual employee (Cohendet and Llerena 1998). In any sizable firm, knowledge of complex production processes is necessarily distributed and cannot be fully grasped or controlled by a single individual. A primary role of an organization becomes that of coordinating dispersed and diffused knowledge (Hayek 1937) Routines and rules within a firm have double nature, providing a mechanism for conflict reduction and problem solving as well as a means for governance and control of collective actions.

New firms are carriers of radically new innovations both in terms of technology and organizational approaches. Existing firms have the advantage of being able to assimilate cumulative changes, but for long-standing firms, wholesale changes of core routines can increase firm mortality (Holzl 2005). Two relatively unexplored aspects of the evolutionary theory of the firm are how routines change over time (and what are the mechanisms by which changes in routines are generated and carried out) and how the role of entrepreneurship affects the potential for conflict or cooperation within the firm and between management and shareholders.

Critics of evolutionary theory, among them many traditionally-minded economists, are uncomfortable with the theory's disdain for fixed economic laws and principles. The theory implies that no law could apply universally, because time and space are in constant flux. The transformation of ideas, technical capacity and social knowledge determines what dominates all economic phenomena, including factor inputs and product/services outputs, prevailing technologies and organizational structures. Evolution represents a genealogy of macro-economic systems that emerge either through Darwinian evolution or through emergence of "critical masses" (Witt 2004).

3.9 Knowledge and Creativity Theory

The term intellectual capital was perhaps first used in 1958 by financial analysts looking at the performance of science-based companies such as Hewlett-Packard. The high stock valuations of the companies, according to the analysts, could only be attributed to an intellectual premium (Stewart 2001). In 1959, Peter Drucker defined knowledge as an important, albeit difficult-to-measure, resource for corporations, and Edith Penrose framed the idea of competence-based competition, which was later expanded by Wernerfelt, Barney and others into a full-fledged modern resource-based theory of the firm (Marr and Spender 2004).

Penrose may have concentrated more on learning activities internal to the firm as sources of innovation, rather than on efficient utilization of resources or appropriation of returns from those resources. Growth of a Penrosian firm is based largely on managerial discovery and use of underutilized resources. The necessity for entrepreneurial vision is because knowledge is dispersed throughout the organization, or due to ignorance or some other deficiency, external to the organization (Hayek 1945). Although Penrose can be cited for many fundamental contributions to the theory of the firm, including a healthy slice of the knowledge and learning theory that stimulated further investigation, she neglected some of the other aspects of resources and capabilities. Firm growth or continuity is made possible by continued expansion of resources and capabilities (not just those attained or instituted by top management); and firms can grow internally or change merger, acquisition, divestment or through new forms of collaboration with other opportunistic organizations in the marketplace.

Generalizing the notion of intellectual capital to a broader concept of the knowledge economy was the contribution of Fritz Machlup, who in 1962 published a study of the production and distribution of all kinds of knowledge in the United States. Machlup estimated that knowledge accounted for 29 percent of GNP, but his work was widely criticized by contemporary neo-classical economists (Godin 2008). To some extent, Machlup was helped by the statistical research of R. M. Solow, who issued a paper showing how science and technology played a role in the production function and therefore influenced national economic growth. Solow recognized three levels of technological change (embodying inventions and new production processes) that could be affected by primary factor and/or intermediate inputs: the first level being progressive technology, with resulting reductions in traditional labor and commodity capital inputs; the second consisting more-or-less of incrementally-improving technology (not Solow's words but an interpretation of them); and the third level, vintage or "one-hoss-shay" [Solow's words] technology (Solow and Tobin 1966). The introduction of non-traditional factor inputs (e.g., useful technology and knowledge) into input-output equations would result, in Solow's terms, either in a quickening or deepening of capital for the industry sector employing the new technology.

In the mid-1980s, Karl-Erik Sveiby observed that the commonly-accepted model for valuing initial public offerings broke down for high-tech companies. He concluded that these companies possessed assets that were not described by financial documents, and in 1989 tried to puzzle out these hidden asset classes in a publication entitled *The Invisible Balance Sheet* (Stewart 2001). Sveiby theorized that this heretofore undesignated class of assets, held in some fashion by organizations, had three origins: first, in the competencies (both individually and collectively) of the organization's people; second, within the internal structure of the organization through patents, models, informational data and administrative systems; and third, by the external relationships of the organization, which consists of reputation, brand recognition and loyalty, and supplier/customer networks (Sveiby 1997). The tri-partite model of human capital, structural/organizational capital and customer/relationship capital has been criticized, dissected and built upon by two decades of knowledge capital researchers, including this appreciative student of management theory.

Proponents of the *knowledge-based theory of the firm* argue that the essentials of a firm include not only its contracting activities, but its function as a repository of distinct productive technological and organizational knowledge (Foss 1996). Thomas Stewart, a long-term editor of Harvard Business Review and author of two books on intellectual capital, penned a cover story for Fortune magazine in 1991 entitled "Brainpower (Stewart 1997). He credited the growth of the new economy to a emerging world of "intellectual capitalists." The gathering forces of thinkers and practitioners about knowledge assets reached a critical mass in the mid-1990s, as Ikujiro Nonaka (with Hirotaka Takeuchi) published *The Knowledge Creating Company* (Nonaka and Takeuchi 1995), and on the opposite side of the globe Lief Edvinsson persuaded his financial services company Skandia to name him as the first-ever Director of Intellectual Capital. Nonaka illustrated his model of how organizations develop and apply knowledge through the SECI scheme – a four quadrant matrix wherein socialization, externalization, combination and internalization of ideas takes place within the context of a firm (Edvinsson 2005). Most enterprises have designed their offices for administrative work, based on old paradigms and inadequate understanding of knowledge creation, Nonaka says, gently chiding some of the companies for which he consults. Instead, he is pioneering the concept of Ba, which is an arena where workplace design (both physical and social) bridges the sharing of information and knowledge. He gives the examples of Honda, where employees are told to work individually and collaboratively by going to the field, asking about the details and then reflecting on the issues to find a greater truth. And of Toyota, where he says the culture of troubleshooting and of finding a better way extends to deep observation and then challenging oneself five times with the question of "Why?" when analyzing and solving challenges and then sharing the syntheses with teammates (Nonaka 2006).

A related collaborative knowledge concept, named the Knowledge Innovation Zone, has been developed by Amidon, and is explored in her book entitled *The Innovation Super Highway* (Amidon 2003). This zone is a geographic region or industry segment or product/service that generates knowledge flows that go from a point of origin to a point of opportunity or need. The focus is on the flow of knowledge and not simply on finances or technology or other more traditional measures. Formation of the new knowledge ecosystems wherein the flows are valued and encouraged has implications for governance and social engagement. Edvinsson suggests looking beyond national GDPs and using something akin to the World Values Survey to ascertain whether a country's economy can really deliver well-being and sustainable wealth (Edvinsson 2008). Interestingly, Scandinavian countries plus Japan and Switzerland rank highest in the survey, and the United States and China are ranked in the second tier of surveyed countries (albeit in separate quadrants – the US is higher in attainment of self-expression values and China for achieving social-rational equanimity).

An increasing body of research is beginning to emerge that looks at differing types and causes of innovation among firms, especially firms offering services rather than goods. For example, Tether analyzed whether firms innovate differently than manufacturing firms (Tether 2005). One of the findings of these enquiries seems to be that external linkages, especially customer linkages, have a positive impact on innovation by service firms. This has led to the argument that the nature of innovation for service firms relies less on the stock of accumulated capabilities (such as R&D activities and patents) than on specialized customer demands and interaction (Mansury and Love 2007). Another strand of research has emphasized the gradations of creativity, beginning with minor adjustments to product or product all the way up to and including system-wide invention. Much of the literature tries to examine the types of innovation that can occur, especially with intangible inputs. Product design innovation, according to one study, can range from 1) incremental steps affecting minor details to 2) significant innovations perhaps involving new-to-firm products or processes, and ultimately radical or landmark innovations that may encompass new-to-world products or processes that can create an entirely new market (Mutlu and Er 2003).

Economic laws underlying the value of intangible assets are explored by Baruch Lev in his book *Intangibles –Management, Measurement and Reporting*, written in conjunction with the Brookings Institution. Lev acknowledges that accountants use the term “intangibles,” while “knowledge assets” is the word of choice by economists, and perhaps “intellectual capital” by lawyers, but they all mean the same thing: a nonphysical claim to future benefits (Lev 2001). Lev succinctly explains that intangible assets are nonphysical sources of value (claims to future benefits) generated by innovation (discovery), unique organizational designs, or human resource practices. He warns that there are both enhancers and detractors to the value of knowledge assets, including the fact that these assets are generally non-rival; that is, they can be deployed simultaneously as opposed to traditional fixed and financial assets where if the asset is deployed, it cannot be deployed elsewhere (leading to opportunity costs due to a business opportunity foregone). Lev also ties a portion of the potential value of intangible assets to networks, because users of technology select systems that they expect to prevail. These non-traditional assets, according to Lev, are especially facilitated by consensus-based standards, where the standards expand network access, reduce consumer uncertainty and shift competition from winner-take-all to market competition (Shapiro and Varian 1999).

But all is not rosy for the potential of intangible assets. Lev decries the limitations due to the high degree of difficulty in managing assets that are not physical and financial (and managing those is hard enough). Well-defined property rights are non-existent and the benefits of intangible assets cannot be fully secured by managers (an employee's knowledge is not owned, but merely "employed" by their organization usually through non-written at-will agreement). Further, there is an absence of a competitive market for intangible assets, so for purposes of classical economics, they are non-tradable. Let's say that, for a moment, some of the knowledge assets can be (and are) traded in the market. These assets have fuzzy property rights and there are some contracting difficulties due to their non-excludability. Nevertheless, there can be increasing returns to scale from intangibles that compensate for the inherent risks (e.g., sunk costs, social rather than private benefits) that characterize these assets (Lev 2001).

3.10 Organizational Composition, Competence and Vision Concepts

Business historians of the 20th century were fond of explaining the origins of vertical integration as firm organization undertaken to eliminate the fits-and-starts in the value chain in order to deliver more product at a cheaper price or higher margin. Problems with unresponsive suppliers, lower uncertainty in price, quality and delivery time of external factors of production, and the inability to negotiate reasonable contracts drove decisions to make internally rather than buy from the marketplace. But a different view of the firm also emerged that considered the firm a repository of competences. Certainly firms are both bundles of contracts and bundles of competences, but the difference may lie in the style of management exhibited by the firm. The contractual approach is more reactive to the market and the competence approach more strategic in terms of the market (Foss 2001).

Rent-earning factors were identified as the totality of the firm's bundle of resources or as the firm's core competencies in an essay by Prahalad and Hamel in Harvard Business Review (Prahalad and Hamel 1990). Competencies, as the root of competitiveness, consist of the collective learning of the organization, especially with regard to coordinating diverse production skills and integrating multiple streams of technology. The researchers even attacked the "tyranny of the business unit," saying that these sub-organizations were too dependent on external sources for critical components, and thereby systematically forgoing opportunities for innovation based on their own lack of commitment or ability to work across the organization to share and apply competence assets (Prahalad and Hamel 1990). Writing at about the same time, Pelikan devised a definition of firm competence from the view of behavioralist economics: First, competence is an informational form of capital that helps an business owner to understand and use information to solve economic problems; Second, competence is often tacit knowledge that is firm and agent-specific; Third, competence is distributed asymmetrically, whether one is looking across firms or across individuals; and Fourth, stocks of economic competence are difficult to measure and compare, rendering them somewhat opaque to empirical research (Palikan 1989).

The problem solving acts of a firm can be conceptualized as combinations of physical and cognitive acts that lead to specific outcomes. The firm's internal organization guides the flow of information across tasks and across the subsets of cognitive labor. The organization possesses specific problem solving competences through its operational procedures and routines, and can generate productive knowledge that further shapes organizational structure (Cyert and March 1963). A firm is an adaptive system that solves problems by relying on routines, operating procedures and shortcuts that are modified through time via problemistic search and adaptive learning (Dosi and Marengo 2007). Without a focus on shared problem-solving approaches, meanings, understandings and values, the firm would spend too much time on disambiguating meanings, eliminating misunderstandings, establishing directions, coordinating activities and negotiating the terms of collaboration (Nooteboom 2006).

A holistic model of professional competence has been proposed by researchers working in the health care field. This model has five sets of inter-connected competences:

- Cognitive Competence – informal tacit knowledge gained experientially as well as underpinning theory and related competence (know-that);
- Functional Competence – things that a person who works in a given occupational area should know and demonstrate (skills and know-how);
- Personal Competency – a relatively enduring characteristic related to effective performance or outstanding performance at a job (drive and behavior);

- Ethical Competency – possession of personal and professional values to make sound judgements in work-related activities; and
- Meta-Competencies – Ability to cope with uncertainty as well as learning and reflection (Cheetham and Chivers 1998).

In acquiring and adapting competencies and capabilities over time, organizations accomplish what can be called organizational learning, and this collective view of organizational knowledge implies that it is firms, or groups of employees within firms, that know how to make complex products like computers and benzene (Winter 1982). Others have emphasized the influences of managerial forces within the firm, including 1) presiding over the replication of well-performing bundles of routines, 2) defining the cognitive frames and aspiration levels of the organization (meaning the shared representations and perceived fitness landscapes), and mastering the dilemma of choosing between exploitation and exploration, which is either concentrating on what the organization is already adept at doing or searching for more innovative opportunities (Dosi and Marengo 2007).

Study of industrial dynamics in terms of organizational competence can be sorted out into various streams of research. Those concerned about the economics of innovation suggest that there is a wide disparity among the technological capabilities of firms, reinforcing the findings of firm heterogeneity including within industries. In the journal articles about industry life cycles, there are patterns of product markets and industries that appear, shake out and later, disappear, with relatively sudden and painful shake-out periods that tend to shape the structure of the industry for long-term. Another stream of research looks at the fascinating topic of "population ecology" of industries, where empirical data shows organizations undertaking activities and either surviving, growing or becoming extinct (predictions of survival probability) based on their choices (Winter et al 2003).

The notion of embodied cognition comes from Nooteboom, who points out that production, the traditional transformation of physical inputs to physical outputs, applies too narrowly to manufacturing in an era where the majority of firms are providing services. The idea of production has to be extended to other ways of adding value to physical inputs and producing physical outputs. Manufacturing yields a utility in form and function, and services yield utilities in terms of time and place (such as in distribution and transport), of financial means and security, of installation and repair, of physical and mental well-being, of knowledge and information, of teaching and consulting, and in a wide variety of other amenities (Nooteboom 2006). Under this service-intensive view, factor inputs and outputs of service production may be intangible, abstract and otherwise non-physical and non-financial, yet nevertheless of value within the market economy.

For modern firms, a critical issue is the ability to remain economically vital through dynamic competencies. Organizations, says Nooteboom, must have the ability to learn, make inventions and transform themselves to avoid the straitjacket of inertia. He cites the growth of the new idea of self-service supermarkets in the 1930s, where an industry upstart (at first rebuffed by his market-leading employer) leaves and grows a chain of eight profitable supermarkets (Cullen's Supermarket) in the throes of the depression, and would have achieved market dominance if the larger chains had not adopted the self-service concept themselves (Nooteboom 2006). When dominant industry structures and approaches are subjected to new challenges that threaten survival of the old order, some existing firms summon the will to make sacrifices by modifying or replacing their worn-out products or processes. Firms that don't wait for external challenges, but instead attempt to institutionalize absorption of novel ideas and have organizational motivation to change for purposes of differentiation and market advantage, are combining vision, strategy and competence –building. These firms, according to behavioral theory, may be beneficiaries of organizational learning that can lead to development of routines for changing routines, and of competency for changing competencies (Argote and Greve 2007).

Process-oriented models of the firm first articulated by Cyert and March, and expanded upon by Nelson and Winter, explicitly acknowledge the importance of competencies and routines. But there is also the recognition that flexibility of those assets and behaviors is limited , and that a changing business environment can force firms to risk their very survival on attempts to modify their internal capabilities and procedures. Firm existence is not guaranteed, but neither does it have to be Hobbesian (that is, nasty, brutish and short). Each day, "it is a groping , incremental process, in which conditions…arise from the actual circumstances of the preceding day and in which uncertainty abounds…[and accordingly] our task is to understand the structure and sources of firm continuity" (Nelson and Winter 1982).

3.11 Nascent Theory of the Sustainable Firm

One shortcoming of the resource-based view of the firm was that it systematically ignored constraints imposed by the biophysical environment. Given the growing awareness of ecological issues, such an omission rendered existing theory inadequate as a basis for identifying emerging sources of competitive advantage (Hart 1995). Similarly, other researchers noted the importance of competing for the future as a neglected aspect of competitive advantage, which impels a firm to continually re-position to maintain its edge in the marketplace (Hamel and Prahalad 1994). For product and services development, this means not only listening to the 'voice of the customer' but taking a step further to listen to the 'voice of the environment' in the selection and deployment of assets (Hart 1995). The concept of strategizing to achieve competitive advantage is incomplete (and may be impossible to obtain) if management does not consider all of the endogenous and exogenous asset classes that may be employed in the firm's production cycle.

Four market imperfections have contributed to environmental degradation: first, firms are not perfectly efficient in their operations; second, externalities exist and are not fully accounted for; third, pricing mechanisms work imperfectly or are inaccurate; and fourth, information is not perfectly distributed (Cohen and Winn 2007). While many government regulations have focused on corporation's failure to protect or enhance the natural environment, one could make the argument that there is also general market failure that has not been fully addressed through legislative or judicial action. However, other researchers say that the techno-centric mindset of policy makers is slowly shifting to an eco-centric mindset, as governments and firms are confronted with broader stakeholder perspectives, including environmental, social and economic goals, rather than narrower shareholder perspectives, which primarily focus on profit maximization, stock growth and dividend distribution (Banerjee 2002).

Institutions, however, have no choice but to continue functioning in the economic sphere and may have severe difficulties in coupling their daily activities with sustainable practices. There are no commonly accepted representational, constitutive or normative rules associated with sustainability, and if companies internalized all activities of social and ecological systems [without a gradual, measured evolution to the new state], they would succeed ecologically but fail economically (Devereaux and Zandbergen 1995). Drawing on a larger tableau, Daly contends that the preanalytic vision of institutions assumes that the economy is a system and the ecology as a sub-system, but the reality is that the ecology is a system and the economy is a subsystem and the two visions are fundamentally irreconcilable (Daly 1996). A popular metaphor in the environmental literature [more than one could list in a single citation] describes oceans of unlimited fish stocks where the limiting factor is the number of fishing boats (economic system-centric) versus a world of limited or declining fish stocks where the number of fishing boats and their extraction capacity exceed the system (ecological system-centric).

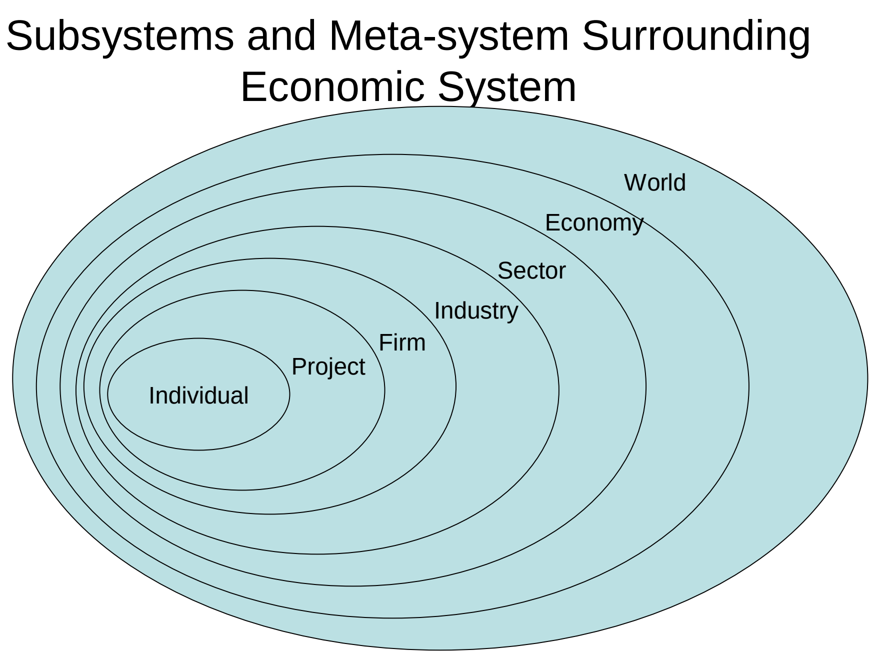


Figure 2 Subsystems and Meta-Systems Surrounding Economic System

If traditional economics is about allocating scarce resources, then economic sustainability can be described as the process of allocating and protecting scarce resources, while at the same time pursuing positive environmental and social outcomes (Doane and MacGillivray 2001). Can firms be expected to both allocate and protect scarce resources and survive the vagaries of a volatile economy? Half of the firms listed in *Built to Last*, a popular management nonfiction book of the mid-1990s are no longer in existence. Companies may be dying prematurely due to the lack of a broader system-based approach where long-term investments are shown to reward shareholders and other stakeholders over time.
Firms fail when poor performance erodes asset stocks, consisting of not only commodity and financial assets but also market position, manufacturing infrastructure and technological capabilities (Thornhill and Amit 2003). The net asset position of firms influences the risk of default to creditors, and it is important that a firm have proper capitalization (multiple asset classes) for survival. Investors do learn about mainstream financial indicators from annual reports, yet useful information about available assets, strategic direction, special management capabilities and prospects for future directions are inexplicably missing (Doane and MacGillivray 2001).

When looking for examples of classes of firms within market sectors and their continuity versus failure rates, early-age failure is regularly associated with the restaurant business where strategy/performance dynamics must deal with changing consumer tastes. By contrast, firms in mining of certain minerals or in specific wholesale machine tools categories have long lives, due to relative constancy in continued demand for output (Thornhill and Amit 2003). Yet somewhere between bankruptcy and monopoly, there likely exists some spectrum of firms demonstrating qualitative continuity that have escaped the attention of researchers.

3.12 Relationship of this Study to Related Research Work

Introduction of the notion of the resource-based view of the firm dates to Wernerfelt's award-winning article that appeared in Strategic Management Journal in 1984, which offered a new look at the firm in terms of its resource endowments (Wernerfelt 1984). In particular, he noted that tangible and intangible assets are semi-permanently tied to the firm, and (due to imperfect markets) the first-mover can form a front-runner position in which it is very difficult for competitors to catch up. Among the assets highlighted by Wernerfelt are machine capacity, customer loyalty, production experience and technological leads. Later contributors to the resource-based view developed a better understanding of specific resources (such as J.B. Barney), and some have suggested that some resources actually have negative values for the firm (such as Rumelt), and that individual resources can sometimes be carefully measured but these measures may not be additive with other resource measures. But the resource-based theory of the firm remains a work-in-progress because, in contrast to the rich taxonomy of markets and substantial technical and empirical knowledge about market structures, resources remain an amorphous heap (Wernerfelt 1995).

Frustrated by the opaqueness of financial statements in explaining the purposes, motivations and cultures of firms, Karl Eric-Sveiby began developing the Intangible Asset Monitor in the 1980s by expanding upon Nonaka and Takeuchi's four modes of knowledge. Sveiby's fundamental concept was that a firm consists of a visible equity and three kinds of "invisible" assets – external structure (brands; customer and supplier relationships); knowledge capital of internal structure (management; legal structure; research and development; software) and knowledge capital of individual competence (education; experience) (Sveiby 1997). The Monitor shows, by reporting on the company's financial and non-financial measures, how the firm might perform in terms of growth/renewal, efficiency and stability. Now two decades old, some have termed the Sveiby research as seminal, a few have criticized it as more practical than academic, and others have simply labeled it as historic (Van Den Berg 2003).

A classic academic discourse about knowledge capital was penned by Teece in the late 1980s, when he grappled with technological change and the nature of firm resources (Teece 1988). He and his colleagues continue to explore how the competitive advantage of firms may rest on distinct processes (ways of coordinating and combining), shaped by the firm's specific asset positions (such as the firm's difficult-to-trade assets and complementary assets), and the paths of evolution that the firm has adopted or inherited (Teece et al 1997). Teece's dynamic capabilities framework suggests that wealth creation during times of rapid technological change depends in large measure on how the firm wields its technological, organizational and managerial processes for new opportunities, and that this active engagement of embracement is more effective than defensive measures to keep competitor's off balance, raise rival's cost or exclude new entrants.

Practical research by Leif Edvinsson at Skandia Corporation in the early 1990s led to development of the Intellectual Capital Navigator. Edvinsson incorporated the idea that intellectual capital represents the difference between market value and book value of the firm (Edvinsson and Malone 1997). Although the model had many shortcomings, many researchers have acknowledged Skandia's enormous efforts to create a taxonomy that would help measure a company's intangible assets. The Navigator instrument also owes a debt to Kaplan and Norton's balanced scorecard approach, because it uses similar organization, structure and processes (Van Den Berg 2003).

Studies regarding intellectual capital measurement in the 1990s multiplied, but most were mired in the narrow slice of knowledge assets having to do with formalized electronic data and communication systems. The studies express frustration with both new knowledge capital measures and traditional financial measures of firm performance. Bontis attributes this dissatisfaction to the embryonic stage of development of knowledge capital assessment and sweeping financial and competitive pressures that have introduced continuing volatility into the economy (Bontis 2000). Nevertheless, using Likert -type surveys and measures, two researchers uncovered a strong and positive relationship between intellectual capital and performance (Bontis 1998, Brusoni 1999).

During the mid-1990s, a handful of researchers concentrated on resources tied to organizational behavior in a competitive context. J. B. Barney at Ohio State University was one of the scholars who tried to better define behavioral resource bundles, and then sought to find how the sets of competencies in a firm related to one another (Barney 1994).

The basic assumption of resource-based theorists is that resource bundles and capabilities of underlying production are heterogeneous across firms, implying that firms of varying capabilities are able to compete in the marketplace and at least break even, and firms with superior resources will earn additional rents (Peteraf 1993). What was vital to Peteraf's argument was that the superior resources or "resource endowments" [Peteraf's term] had to remain limited in supply, and therefore, needed to be immobile and bound to the firm, or imperfectly mobile, so that the resources were not readily tradable or imitatable (Peteraf 1993). What fascinated Peteraf was that competitive advantage could be established not only after the production transformation phase turned inputs into final products, but prior to production based on valuable but nontradeable asset stocks. Equally important to the strategic positioning of the successful Peterafian firm is attaining a superior resource position partly as a result of the fact that there is limited competition for that position.

The Brookings Institution, a Washington, DC based think tank, began an "Intangibles Project" in the late 1990s, with the purpose of researching whether intangible and non-physical factors were more important to national economies than traditional factors. According to the Brookings' lead researcher, intangible assets are non-physical sources of value (claims to future benefits) generated by innovation (discovery), unique organizational designs or human resource practices (Lev 2001). An urgent need exists, says Lev, to understand the role of intangible capital – along with tangible and financial assets – to figure out the true process of value creation. Because of the numerous challenges posed by these intangibles, including spillovers of benefits, high risk and little tradeability, and the lack of measurement tools for individual and collective intangible assets, it is extremely hard to figure out what a company is really worth (Lev 2001).

Touching upon Penrose's exposition about the nature of the firm, Fahy reminds students of management that a firm is more than an administrative unit; it is also a collection of productive resources. The list of resources in any given firm is likely to be a long one, and not all resources are of equal importance (Fahy 1999). Characteristics that help prevent a resource from being copied by competitors, or that make the resource endowment relatively invisible from the competition are 1) tacitness (skill based activity that is difficult to identify and decode), 2) complexity (interconnectedness of asset stocks and social relationships in the firm), 3) specificity (transactions with in the firm and with external constituents are unique to the firm) and 4) regulatory protection or other economic deterrence (Fahy 1999). Fahy concludes that such a list of resources could be categorized according to their ease of duplication by competitors, but hints that such an approach may be too simplistic. A hierarchy of resources assembled over time may lead to a more fine-grained analysis, and such a framework would be consistent with Dierickx and Cool's findings that many resources cannot be adjusted instantaneously but rather are accumulated through consistent investment (Dierickx and Cool 1989).

A concise recounting of Drucker's theory of business is found in Clare and Detore's treatment of knowledge assets. The authors explain how Drucker analyzed General Motors in the 1920s as a firm that interpreted the demand for motor cars segmented by income group, thereby stimulating a need for a limited number of models with fairly high trade-in value so customers could move up in status as reflected in the model and brand. The resulting mass production approach and multi-division business organization fit the world, fit the business alignment criteria, became widely accepted and adapted as the world changed (Clare and Detore 2000). Ninety years later, the corporation is failing because it abandoned, for the most part, being an adaptive system which would have maintained the correspondence and coherence relationships with customers and potential customers. Horizontal process-oriented organizations have begun to be eclipsed by networked organizations over the past 25 years or so. Some researchers have observed firms moving from functioning under value chain organizational principles to network models called value constellations (Normann 1993).

Clare and Detore insist that knowledge is a factor of production, but a factor that is more easily valued through investment-based models than accounting-based models using real-option value techniques (economic value created by keeping options open). Managers are employed to systematically improve the yield of knowledge assets of the organization by understanding firm knowledge assets, by identifying firm differentiators, by squeezing more value out of what is known and by acquiring knowledge for future positioning and action in a way that is more competitive than rivals (Clare and Detore 2000). Although the work is primarily intended as a tool for management decision-makers, the researchers ground their assumptions upon an off-balance sheet taxonomy that says intangibles need only to have the promise of future economic benefit to be classified as one of eight types of knowledge assets. The incisiveness and clarity of Clare and Detore's illuminating treatise about knowledge assets can be contrasted with Standfield's tantalizing but ultimately self-serving *Intangible Finance Standards*, which seems to provide just enough of the professor's insights to make firms want to hire him as a consultant, but leaves the student of knowledge theory with a palpable distaste for his blatant capitalization on the intellectual assets movement, compounded by his refusal to disclose any new knowledge uncovered by his research (Standfield 2005).

Second generation intellectual capital models have been devised by Pike and Roos, among others, wherein more complicated models (purportedly to better reflect business realities) are designed to utilize a multi-attribute value approach to identifying, classifying and weighting knowledge assets. The model includes a systems dynamics model that incorporates a business navigator showing resources and important transformations of intangible resources, coupled with a financial model that incorporates risk, to ultimately show indicators for cost effectiveness of intangible resources put into value stream (Pike and Roos 2001). Drawing upon intellectual capital resources categories originally developed by Edvinsson, Roos divides these nonmonetary and nonphysical resources into relational (organizational relations with customers, suppliers, partners, etc.), organizational (processes, systems, brands, structures, data, etc.) and human (competence, attitude, skill, tacit knowledge, etc.) (Roos et al 2005).

By combining a resource distinction tree (firm's total asset base according to Roos) with the value chain, value shop and value network theory of Stabell and Fjeldstad, Roos designed a value logic diagram that approximates what this researcher developed independently in the United States. However, the scheme proposed by Roos is weighted down by a genuflection to traditional economics. Roos calls his intellectual capital measurement system the conjoint value hierarchy , which consists of 1) an indexing system to capture asset details particular to an individual firm, 2) resource indicators for specific knowledge assets, 3) transformation indicators for value goals (endpoints for transformation of specific resources), and 4) calculation of indices over time to show how management interventions can improve company performance through a transformational exercise (Roos et al 2005). Nevertheless, the methods explained by this Scandinavian-based research scholar do not adequately explain the shortcomings introduced by combining resource measures and indicators, and Roos ignores the distinction between produced and natural capital, thereby severely limiting the use of his model for firms concerned about corporate social responsibility.

Galbreath tests whether intangible resources are more important determinants of firm success than tangible resources in his empirically-based thesis work. His conceptual model includes both tangible and intangible assets, and he is careful to identify resource constructs (bundles of resources) to analyze rather than succumb to the easy temptation of testing a single resource at a time (Galbreath 2004). Similarly, he recognizes and anticipates that dynamic capabilities found through intangible resources are a key source of firm survival in the modern, hypercompetitive economy where most commodities can be easily bought on world markets, but company-specific capabilities can be built from within. Galbreath tries to show that bundles of constituent skills coupled with technologies can be the differentiators for firm competitiveness, when the product/market side of the firm's activities are homogenous or nearly identical to that of rival companies (Galbreath 2004). Unfortunately, Galbreath uses a relatively modest pool of Australian firms that are drawn from only two of the four identified sectors (value chain, value shop, value network and composite). Because of Stabell's (1998) earlier work on value shop enterprises (as a complement to value chain, value network and composite firms), and because the value shop model is most applicable to A/E/C firms, then this thesis, if successful, is intended to partially bridge this gap of knowledge.

Overall, most empirical research stemming from resource based theory has fallen short in exploring and identifying which types of resources or what classes of resources are the more important determinants of firm value and continuity. Despite the shortcomings of previous studies, they offer conceptual insights into the variety of resources available to firms, and they demonstrate that using individual resources or resource bundles (independent variables) is a valid method for investigating firm success or failure (in this case, using value and continuity as success constructs or dependent variables).

"The medieval historian Clanchy commented on the slow and largely reluctant acceptance in 11th and 12th century England of written documentation (a new form of encoded knowledge), recording that both to ignorant illiterates and sophisticated Platonists, a written record was a dubious gift because it seemed to kill living eloquence and trust, and substitute for those living things a mummified piece of parchment." __ Shoshana Zuboff 1988

"*To substitute capital stock (saws and hammers) for natural stock (wood) is only very marginally possible, if at all…I think it is sufficiently clear to common sense that natural and man-made capital are fundamentally complements and only marginally substitutable…and the remaining natural capital is scarce and therefore limiting*." __ Herman Daly, 1996

CHAPTER 4 TANGIBLE AND INTANGIBLE ASSETS/STATIC AND DYNAMIC ASSETS – NATIONAL SYSTEMS, INDUSTRIAL SECTORS AND FIRM RESOURCES: FOUNDATIONS AND DEFINITIONS

4.1 Physical and Financial Assets

It is an axiom that net worth (or stakeholder equity) is equal to assets minus liabilities. When a company (or a nation) has positive net worth, the economic sustainability of the entity is seen on the system of accounts at the end of the fiscal year, usually through an aggregate balance sheet. Entities that have greater assets than liabilities (in total value) are, at least according to the end-of-year snapshot of a balance sheet, growing in terms of net worth. Entities that have greater liabilities than assets may draw upon reserves or seek additional capitalization through shareholder equity; however, investors will want to see rapid improved performance. Absent a financial condition that promises increasing dividends or growth in share value, equity shareholders will head for the exits. The company may declare bankruptcy and re-structure, or in more dire circumstances, cease operations and liquidate remaining assets.

Classical economic assets, as identified by Adam Smith and other early macro-economists, are land, labor and capital. While these appellations sound a bit quaint and are in some ways ill-suited for today's economy, the use of these categorizations persist in basic economics textbooks. A more contemporary compilation of assets is found in the US

Generally Accepted Accounting Principles (GAAP), which lists current assets, long term assets and fixed assets as three categories of physical and financial assets:

Current Assets –

- Cash – currency, bank deposits and active negotiable instruments (bank drafts, money orders, checks, etc.)
- Short term investments – usually securities
- Receivables
- Inventory
- Pre-paid expenses

Long Term Assets

- Investments – bonds, common stocks, notes
- Land held for sale
- Special funds – such as sinking funds or pension funds
- Investment shares in subsidiaries or affiliates

Fixed Assets (also known as PPE)

- Property – land, buildings
- Plant – machinery, tools, manufacturing lines
- Equipment – tools, furniture, IT hardware
- Resources – timber, minerals, etc.

The International Accounting Standards Board (IASB) defines an asset as a resource controlled by an enterprise as a result of past events and from which future economic benefits are expected to flow based on deployment of the asset by the enterprise (IASB 2008). Assets exhibit three basic characteristics: first, the asset will have a probable future benefit that involves a capacity, either singly or more likely in combination with other assets, to contribute to the value of future products or services; second, the enterprise has partial or full control of the asset, and of the future benefits that may derive from the benefits of the asset; and third, for financial accounting purposes, the transaction or similar event providing partial or full control of the asset has already occurred so that the asset is recorded ex-post and included (usually in a cumulative category, rather than as an individual asset) on the balance sheet.

Among the tests used by professional accountants to determine the existence of a traditional fixed or financial asset are 1) discreteness (is the asset individually distinct and separable so that it may be properly measured); 2) observability (the asset or effects of the asset can be directly seen or touched); and 3) control (the asset is fully owned, or through another ownership or partial ownership mechanism, within the directorial dominance of the company or its management) (Blair and Wallman 2001).

Resource-based theory suggests that firms are bundles of assets (Marr et al 2003; Coad 2008). The question for researchers, shareholders and potential investors then, is how does one identify the assets at a firm's disposal? Only conventional assets are discernable from the firm's financial balance sheet, usually lumped into general accounting categories. A few additional assets may be revealed in the firm's annual report to stockholders. Other assets may be hidden from the surface, like the submerged part of an iceberg, either providing buoyancy for the tip protruding into the sunshine or pulling down the mass into the depths of the sea, depending on the observer's perspective or the ethics of the firm. In the 1990s, the term "off balance sheet" became well-known, as some major corporations held assets or financing activities that were not identified on their published balance sheets. An item should appear on a firm's balance sheet if it is an asset that is formally owned or legally controlled by the company, whenever these assets are probable, measurable and meaningful (SBA 2004). In cases such as ENRON, the corporate giant that went bankrupt in late 2001, hidden assets (those assets or liabilities purposefully kept from view of external observers), coupled with the complicity of senior management, contributed to the demise of the company.

For business valuation, it is often the ferreting out of asset quality and quantity for valuation purposes that comprises the bulk of the valuation service. Valuation of an asset or liability consists of estimating its potential market value, and is done in a variety of circumstances, such as in capital budgeting, investment analysis, mergers and acquisitions, tax reporting or litigation. Firms often want to list their assets at their original cost basis (historic cost) rather than current market valuation; however, GAAP requires that some types of assets be shown at market value (called mark-to-market). This convention gives company financial managers in publicly-held firms opportunities to artificially increase profits and stock prices, sometimes in the interest of expanding the bonuses of the corporate leadership. On the other hand, private firm managers prepare their financial statements to minimize profits, and therefore taxes, so the net result is typically an undervaluing of firm assets. When assessing market values of firm assets, it is important for appraisers to understand management's motivations and biases (Reilly and Schweihs 2004).

Actual valuation of traditional financial and physical assets in commonly done through business valuation studies or periodic audits of firm finances. The discounted cash flow method estimates the value of an asset based on its future cash flows but discounted so the asset's future value is shown in today's dollars. The size of the discount is based on the decision made by the evaluator (or investor) based on opportunity costs because the individual is usually faced with two or more investment choices. By making a choice to invest in one firm or venture means that the investment dollars will not be available for another firm or venture; hence firms or investments that are more risky must pay higher returns if they expect to attract financial capital. Asset evaluators also use comparables to estimate asset values, by looking at guideline companies (similar companies) in the marketplace. By employing the average price-to-earnings multiple of a guideline company to the firm being evaluated, one can generate the value of the target firm based on those multiples. There are a number of other asset valuation techniques, such as those using absolute or intrinsic value models or option pricing models that are held out by the accounting profession as defensible approaches to baseline costs, which are then subjected to additions or subtractions in value based on the opinion of the observer of the firm's "going concern" prospects. But in actual practice, it is the bundle of resources at the firm's disposal, the production efficiencies of the firm, the positioning of the firm in the marketplace, and the strength or weakness of marketplace demand for goods or services, that ultimately determine the book value and estimated market value of the firm in any given quarter or year.

4.2 Intangible and Knowledge Assets

Testifying before the Senate Committee on Banking, Housing and Urban Affairs during the summer of 2000, four respected economics and accounting experts lamented that the 1930s financial reporting model for corporations was woefully inadequate to convey the condition status of a firm, primarily due to inadequate treatment of intangible assets. The shortcoming was primarily attributed to the asymmetric treatment of capitalizing physical and financial investments while expensing intangibles, which the Congressional panel of experts called biased and deficient reporting of a firm's performance and value (Lev 2001). Intangible capital appears in a variety of forms. When intangible assets are protected with the law, they are often in the form of patents, trademarks, contracts or licenses. But intangible assets can also be unprotected and devoid of specific legal rights, such as "know-how" within the firm. Intangible capital is increasingly present in the form of organizational assets that are manifested as unique processes or managerial approaches. The ability of certain types of firms (such as services-oriented firms) to use these intangibles to help achieve efficiencies and create value can sometimes be greater than what could have been achieved with traditional physical and financial assets.

Writing in the Academy of Management Review in 2007, Dean observed that the literature suggests the arrival of a distinct new factor of production – intellectual capital – either replacing or supplementing land, labor and capital…[as seen by] the decline of manufacturing (Dean 2007). Conceptually, students of economics can accept the existence of intangible capital if it is understood that capital facilitates the creation of value, even if it does not possess instant value in and of itself. That is, there are agents of production that are not primarily physical and financial, but can nevertheless enable or improve the production process for the spawning of new goods and services. Drucker treated knowledge or intellectual capital as a distinct form of capital that could not be substituted for by traditional forms of capital, and suggested that both traditional and human capital should received ongoing attention and investment by management (Drucker 1985).

Intangible assets present three kinds of problems for organizations:

- First, some intangible assets can be owned and sold; that is, considered as property when they are codified and articulated, such as through patents, trademarks and copyrights.
- Second, some intangible assets can be owned and controlled but not separated out and sold in the marketplace, such as research and development-in-progress, business secrets, reputation, proprietary management systems and business processes.
- Third, some intangibles may not be owned by the organization, or ownership may be contested, such as human capital, organizational capital and relational or social capital, which do not meet tests for professional accounting of assets, which would include discreteness, observability and control through unequivocal ownership (Hunter 2002).

There are many types of intangible assets that are of importance to firms and relevant to ongoing firm management. In the mid-1990s, researchers pointed out the need to separate the concepts of data, information, explicit knowledge and tacit knowledge (Nonaka and Takeuchi 1995). Knowledge management takes off from a practical acceptance that people have to struggle with bounded rationality and incomplete information (J.C. Spender 2008). Polyani explored tacit knowledge to explain the relationship between logical mental activity (scientific knowledge) and skilled practice, such as expertly flying an airplane. The conception of an applied skill is the marriage of explicit knowledge (such as good planning) and what emerges from a human source such as an innate or learned capability. Knowledge assets begin to have more meaning when knowledge deficits (imperfect knowledge or absences of knowledge) are also considered.

A number of journal papers published during the 15 years from 1994 to 2008 tried to identify and assess intangible and knowledge assets. Skandia was the first corporation to make a comprehensive effort at measuring knowledge assets, building an internal system for intangible assets data collection in 1985 and issuing its first report to shareholders in 1994. Edvinsson's Skandia *Navigator* created an accounting taxonomy consisting of five areas of focus: financial, customer, process, renewal and development, and human capital (Bontis 2000). The Skandia report (1997 version) lists 112 metrics, such as:

Table 4   SELECTED SKANDIA INTANGIBLE ASSET MEASURES
(adapted from Edvinsson 1997)

Financial Focus	✓ revenues per employee ✓ revenues from new customers/total revenue ✓ profits from new business operations
Customer Focus	✓ number of days spent visiting customers ✓ ratio of sales contacts to sales closed ✓ number of customers gained versus number lost
Process Focus	✓ number of PCs in company vs number of employees ✓ IT processing time and IT capacity utilization
Renewal and Development Focus	✓ satisfied employee index ✓ training expense divided by administrative expense ✓ average age of patents and trademarks
Human Focus	✓ managers with advanced degrees ✓ managers with special accreditation, certification or licenses ✓ annual turnover of staff

Both Sveiby (Intangible Asset Monitor) and Brooking (Technology Broker) independently developed intangible asset assessment frameworks that follow, to some extent, the Skandia model. Sveiby, however, believes that money should cease being a proxy for human effort, because the use of a secondary medium of exchange fails to adequately capture the greater complexity of intangible concepts such as competence and stability that are built over a long period of time. Edvinsson and Malone recognize three essential stores of knowledge in firms: customer capital, structural capital and human capital. The five indicators of customer capital include customer type (customer base as of present and predicted growth), customer duration (degree of loyalty to firm or its products), customer role (customer's activities in the firm's value chain), customer support (how the company gains customer satisfaction) and customer success (how products or services of the firm assist the customer in achieving goals). Structural capital is the set of processes, systems and routines that make up the business's operations. The routines may be unique to the company, and these distinctive attributes are part of its competitive advantage. Human capital many include employment, training, turnover, service length, empowerment, knowledge sharing and motivation (Edvinsson and Malone 1997).

Teece created a useful comparison of the properties of tangible and intangible assets:

Table 5 BASIC DIFFERENCES BETWEEN TANGIBLE AND INTANGIBLE ASSETS (Teece 2000)

ASPECT	TANGIBLE ASSETS	INTANGIBLE ASSETS
Publicness	Use by one party prevents simultaneous use by another	Use by one party need not prevent use by another
Depreciation	Wears out over time; may depreciate rapidly or slowly	Does not wear out; but usually depreciates rapidly
Transfer Costs	Easy to calibrate by looking at transport and related costs	Difficult to calibrate, and increases due to tacitness
Property Rights	Generally comprehensive and clear under legal system	Limited to items that can be patented or copyrighted
Enforcement of Property Rights	Relatively easy	Relatively difficult

Professional accounting's tests for tangible fixed and financial assets – discreteness, observability and control – were discussed earlier in this chapter. A parallel set of tests was advanced by J.B. Barney in 1991 to determine the existence of intangible assets within a firm. This theoretical view of the characteristics of heterogeneous firm assets has been regarded by some as the beginning of a full-fledged resource-based theory of the firm (Mintzberg et al 1998). Barney argued that neoclassical economists, including those as recent as Porter, treated resources employed by firms in their production processes as identical (the neoclassicists maintain that firms have access to the same resources as their competitors). Led by Barney, Peteraf and others, the resource-based school rejected that assumption, and thereby helped to elevate the importance of factor inputs in microeconomics to that of outputs and wealth generation.

Barney suggested that resources are sources of competitive advantage when they are valuable, rare, inimitable and non-substitutable – the VRIN model – which has been prescription for firm success under the resource-based school for over 15 years. *Valuable* resources are those bundles of resources that a more effective or efficient than the firm's competitors, allowing the firm to enjoy better performance in the marketplace. Having those sets of resources may enable the firm to satisfy customer needs at lower costs, or may allow the firm to exploit opportunities or neutralize threats by competing enterprises (Barney 1991). *Rare* resources are those possessed only by a few competitors, or in the ideal situation from a competition standpoint, by only one firm. On the other hand, if a large number of firms in the same industry hold the particular asset, regardless of whether the asset is valuable in and of itself, then the ability of a small number of firms (or one firm) to generate competitive advantage is diminished. *Inimitable* resources are those that cannot be (or are very difficult to) imitate, therefore are relatively unique to the firm. Inimitability may come from a variety of sources, including causal ambiguity (limited understanding by competitors of what makes the front-runner successful), property rights (where patents, trademarks and copyrights protect use of the asset) and social complexity (a firm may possess a specialized culture that is difficult, if not impossible, to replicate) (Dierickx and Cool 1989; Nelson and Winter 1982). *Non-substitutability* is the fourth test for a resource, where individual assets cannot easily be replaced by other competitors, and the competitor must resort to acceptable substitutes rather than perfect substitutes, which will likely lower the rent-generating capacity of the enterprise (Peteraf 1993).

To absorb more of the assets meeting both traditional and resource-based tests, a more recent and expanded asset accounting framework has been put forward by the Enhanced Business Reporting Consortium (EBRC). This group is concerned with corporate reviews of business landscape, strategy, resources and processes, as well as performance. Its guidance document includes traditional monetary and physical capital assets, but also instructs users to capture relationship capital assets (relationships with other organizations and third parties, including joint ventures, contracts, alliances and more informal relationships); organizational capital (processes not reported in financial statements and that are independent of employees, such as formulas, databases, methodologies and processes); and human capital(attributes of the workforce, whether employees or contractors of the firm, as well as their education, skills, abilities, experiences, attitudes and accomplishments) (Jarboe 2007).

An equation to sum the different elements of intellectual capital assets (a subset of intangible assets) has been advanced by Hunter (2002):

IC = IP + PID + K1 + K2, where

IP represents the firm's intellectual property in the form of patents, trademarks, etc.; PID is the intellectual property that is in the research or development stage; K1 is the articulated knowledge of specific organizational systems, templates and operating procedures; and K2 is tacit knowledge found in the know-how of individuals, teams or the entire organization.

A more expansive model is found in Low and Kalafut's Value Creation Index, which is based on the following intangibles (Low and Kalafut 2002):

Management and Leadership Assets –

- Strategy and Execution
- Communication
- Transparency

Organization --

- Technology and Processes
- Human Capital
- Workplace Organization and Culture
- Innovation
- Intellectual Capital
- Adaptability

Relationships –

- Brand Equity
- Reputation
- Alliances and Networks

Blackler suggests focusing on kinds of knowledge assets that capitalism currently demands, which are the organizational systems through which knowing and doing are achieved (Blackler 1995). This researcher organizes this subset of organizational assets into a Johari's Window (adapted from Blackler 1995):

	Focus on Familiar Problems	Focus on Novel Problems
Emphasis on Collective Endeavor	**Knowledge Routinized Organization** *Emphasis on knowledge embedded in technologies and routinized procedures* *Hierarchical control and division of labor* *Machine bureaucracy as in a factory* *Relatively low skill requirements* Current Issues: Computer integration and corporate strategies	**Communications Intensive Organization** *Emphasis on encultured knowledge and collective understanding* *Collaboration is a key process* *Expertise is pervasive* *Innovation-mediated production* Current issues: Computer-supported cooperative work and collaborative process improvements
Emphasis on Contribution s of Key Individuals	**Expert Dependent Organization** *Emphasis on embodied competencies of key employees* *Performance of specialist experts is key* *Heavy emphasis on education and qualifications* Current issues: Development of individual competencies and using software to replace replicable skills	**Symbolic Analyst Dependent Organization** *Emphasis on embrained skills of key employees* *Entrepreneurial problem-solving* *Status and power from creative achievements* *Knowledge intensive networks & problem solving* Current issues: Information support and expert systems design

Figure 3 Blackler's Window on Organizational Systems

Despite the extensive empirical research dedicated to intangible assets of firms, no widely-accepted classificatory listing of intangible assets has emerged. Only a handful of researchers have insisted that any broader listing of firm assets must necessarily <u>include traditional physical and financial assets</u> along with more-recently identified intangible assets in an effort to provide a comprehensive view of firm resources. It is on the side of this minority research opinion that a system of *organizational total asset accounts* is proposed in Chapter 6 of this research project.

4.3 Static and Dynamic Assets (e.g., Assets Held for Value; Assets Put to Work)

Dynamic capabilities of the firm are those that enable the firm to innovate and to turn those innovations into economic benefits for the firm (Nelson 1991). The mere presence of resources within the firm is not sufficient to create ongoing value. Succeeding (in a changing market) means deploying resources and transforming one resource into another (Roos 2001). The dynamic capabilities school of thought emphasizes the adaptation, integration, reconfiguration of internal and external organizational skills, resources and functional competencies toward changing environments (Teece and Pisano 1994).

Firms that emphasize the development of management capabilities, and difficult-to-imitate combinations of organizational, functional and technological skills can uncover newer sources of competitive advantage (Teece et al 1997). At various points in their business, firms make long-term quasi-irreversible commitments to specific domains of competence, including the formation or acquisition of dynamic capabilities. The term dynamic refers to the capacity to renew competences so as to achieve congruence with changes in the marketplace, because innovative responses may be necessary when technological change is rapid, or time to market is critical, or the nature of new competition throws novel challenges in the path of the firm. By contrast, assets that are homogenous and can be bought and sold at established prices are probably not strategic, and are likely what could be termed static resources (Barney 1986). Constant surveillance of markets and technologies, and the willingness to adopt best practices, can significantly help a firm in a volatile market. By contrast, narcissistic organizations in love with their ossified resources and routines are likely to be impaired (Teece et al 1997). A particular set of processes and positions can lose their value if they support competences that no longer matter in the marketplace, or if these positions and processes can be readily replicated by competitive organizations.

Because of globalization, the economic world is shrinking and access to tangible assets alone does not ensure competitive advantage for firms. Traditional assets (physical and financial) are increasingly transient (Marr and Spender 2004). Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight used for incorporating new information and experiences. The organic view of knowledge places knowledge as a dynamic and tentative combination of data, meaning and the ability to generate proficient practice (Roos 1997). Some researchers see knowledge flows in firms as embodiments of dynamic assets. Lonnqvist and Markova suggest five incidences of knowledge flows in organizations:

1.) Knowledge flows are a way to create new knowledge, as from an interaction that may consist of socialization, externalization, combination or internalization among individuals as information is transformed through its movement, accretion and evolution.
2.) Knowledge flows are a way to transfer knowledge from individuals to groups, groups to individuals, explicit sources to individuals or groups, and otherwise through working relationships in the organization. Knowledge flows can arise internally from within the organization and from external sources such as customers, especially for knowledge intensive and value shop firms.
3.) Knowledge flows are a way to utilize previous knowledge, as through existing routines and mentorship capabilities. Sharing of corporate culture and best practices are concrete examples of these applications.
4.) Knowledge flows are a way to understand knowledge, which is a perpetual process as differing views and opinions, directions and dictates, ideas and actions continuously arise from continuous interaction.
5.) Knowledge flows are enabling infrastructures, which inform the operations of the firm and make it path dependent according to routines and practices embedded in the organization (Lonnquvist and Markova 2006).

The effects of knowledge management activities are multi-dimensional, and can create effects that are not directly linked to a specific activity within the firm. The evaluation of a knowledge value project resembles the evaluation of an innovation process, which has several complexities. The use value of knowledge to the organization is directly dependent on the context in which it is used, which ties these dynamic applications to firm strategy, organizational direction and the external economic environment (Mouritsen 2005). Capitalizing on knowledge resources for improved enterprise performance depends on rapid and efficient transfer from one part of an organization to another, or from a specific application in time to another later application (Nissen and Levitt 2002).

The Meritum project attempted to place assets in a table of static and dynamic concepts:

Table 6 ASSETS AS STATIC AND DYNAMIC CONCEPTS (Meritum 2001)

	Static Concept	Dynamic Concept
Tangible Assets	Available Capital	Capital used to buy machine tools to increase product output
Intangible Assets	Existing Competencies	Developing new intangible assets within the firm Acquiring new intangible assets from outside of the firm

As a dynamic concept, intangible activities consists of three activities: First, developing or acquiring of new intangible assets; second, increasing the value of current intangible assets; and third; assessing an controlling intangible activities (Meritum 2001). The dynamic concept can apply to tangible or intangible assets, according to Lonnqvist, and his definitions are recounted here:

Asset refers to an entire property of a person, association, corporation or estate applicable, or subject to the payment of debts; or an item owed. Assets that are *capital assets* are those that add to the long-term worth of a corporation, and consist of accumulated possessions calculated to provide net worth or to bring in income; and are usually devoted to the production of other goods. *Tangible* refers to the capability of being perceived by the sense of touch; substantially real or capable of being precisely identified in the mind; and capable of being appraised at an actual or approximate value. *Intangible* refers to something that is unable to be touched; or something that cannot be precisely measured or assessed and therefore may be somewhat abstract, such as goodwill (Lonnqvist 2002).

Table 7 General Evolution of Resource-Based Asset Classifications

RESEARCHER(S)	GENERAL ASSET CLASSES	YEAR
Penrose	Fixed and Financial Assets/Intellectual Assets	1958
Sveiby et al	Tangible Assets/Intangible Assets	1987
Daum (after Veblen)	Material Assets/Immaterial Assets	1998
Quah	Weighted Assets/Weightless Assets	1999
Courtney & Holtham	Inanimate Assets/Animate Assets	2000
Teece	Static Assets/Dynamic Assets	2001
Bragdon	Non-Living Assets/Living Assets	2006
Beard	Corporeal Assets/Volitional Assets	2009

Whether one is examining fixed or financial assets, the so-called tangible assets, or organizational and human assets, the so-called intangible assets, there are groups of resources that are held for value, and others that are placed into the production cycle. Boudreau, working at the Department of Advanced Human Resource Studies at Cornell University, has developed a model that categorizes knowledge assets depending on whether they are residing in a reservoir or moving through a system (as in a network of pipelines or a river with tributaries). Stocks, in Boudreau's organizational scheme, are the existing levels of knowledge at a specific point in time, which are held within the organization's members, tools, procedures and connections. Flows are the movement of knowledge assets between entities, individuals and organizations that nurtures new knowledge and may, on occasion, retire old knowledge. Enablers are the investments, processes and activities aimed at changing or maintaining levels of knowledge stocks or actively influencing knowledge flows where it serves to benefit the organization (Boudreau 2002).

Taking Boudreau's framework just a step further allows one to fit static assets, held by the firm for value (or to provide a strong balance sheet), within the class of resource stocks; and to take flows, incorporating both applied tangible and intangible assets used in the production process, and place them in the class of dynamic resources. Boudreau's concept of enablers, however, is problematic. A better term, indeed a stronger concept, would have been the twin alter egos of knowledge stimulators and knowledge inhibitors. Using these terms helps to explain how the forces influencing flows can be either positive or negative in their ultimate impact on the level of stocks held by the firm. Management is better served when one can explicitly understand how behaviors and decisions (pivotal roles) will help or hinder the value of total firm assets, regardless of whether those assets are of the tangible or intangible variety.

4.4 Organizational, Competence and Motivational Assets

Sveiby outlines three families of intangible assets; namely, external structure, internal structure and individual competence. The external structure is seen as intangible relationships with customers and suppliers, which form the basis for reputation or image of the firm. The value of the external structural relationship can be tied to how well the firm solves the customers' problems, and how the brand is viewed by the marketplace. Relationships and reputations can change over time from fairly good to fairly bad, and this relationship is often firm-based and not tied to individuals. The internal structure is made up of administrative tools and processes that are part of the culture or spirit of the firm. Competence of individuals, internal networks, concepts and models are also part of this family. If a key individual leaves a firm, it can still use the organizational internal platform to hire similar talent to start anew. The individual competence area consists of all of the abilities of staff working in the firm, to the extent that they are devoted to the value creation activities of the firm. Competency levels are influenced by experience, formal training, individual acumen and pace of change of the activities undertaken by the company (Sveiby et al 2002).

Lonnqvist captures Sveiby's concept families in a tabular format, adapted here:

Table 8 FACTORS RELATED TO AN ORGANIZATION'S INTANGIBLE CAPITAL (Lonnqvist 2002)

EXTERNAL STAKEHOLDER-RELATED CAPITAL	INTERNAL STRUCTURE-RELATED CAPITAL	EMPLOYEE-RELATED CAPITAL
1. Relationships with customers 2. Contracts and arrangements with customers 3. Organizational image and brands 4. Other stakeholder relationships	1. Technologies, such as information systems and databases 2. Organizational processes 3. Culture and values 4. Management philosophies 5. Patents, copyrights and trade secrets	1. Knowledge and competencies 2. Experience 3. Education 4. Creativity and innovativeness 5. Other key attributes, such as leadership and entrepreneurship

The creation of organizational capabilities can involve many different processes. Depending upon the origins of the process or the intensity of the effort, performance levels can change due to ongoing routines, spontaneous improvisation or novel production. Routines can contribute to organizational transformation as well as contribute to a firm's sometimes harmful inertia, but improvisation is usually seen as a positive contribution to the firm's adaptability, even if the adjustment is merely a "work-around" to some glitch or discontinuity in an existing routine (Gong et al 2006).

Competence assets have been associated with effective management behavior and strategic thinking within a firm since the American Management Association identified five key clusters of competencies in the 1980s. The US Secretary of Labor during the Clinton administration re-classified these clusters as resources, interpersonal, information, systems and technology (Le Deist and Winterton 2005). A more holistic model of professional competence has been advanced that includes cognitive competence (know-that knowledge that is underpinned by know-what understanding), functional competence (know-how that is present and able to be demonstrated), personal competency (defined as relatively enduring characteristics of people providing effective or superior performance in their jobs), ethical competency (appropriate personal and professional values of employees, plus the ability to make sound judgements during work situations), and meta-competencies (ability to cope with uncertainty, plus the capability of learning and reflection) (Cheetham and Chivers 1998). Le Deist and Winterton argue that one-dimensional frameworks for competence are giving way to multi-dimensional frameworks that necessarily include cognitive, functional and social competences. These three dimensions are consistent with the French approach, which consists of *savoir, savoir faire* and *savoir etre*, as well as knowledge, skills and attitudes (Le Deist and Winterton 2005).

Furu warns that having a collection of highly competent people does not automatically translate into a great team or organization. It requires that the organizational, leadership and motivational factors be in place to produce organizational performance (Furu and Lehtonen 2008). If changing business conditions suggest that management needs to pay more attention to factor inputs as opposed to being preoccupied with production outputs in the new economy, Galbreath argues that leaders of firms would be prudent to focus on developing and deploying intangible assets rather than tinkering with firm structure. Dynamic capability is the key source of firm performance, if not survival, in a challenging economy (Galbreath 2004). Firm strategy and market value are dependent on tangible physical assets as well as individual and collective human action (both leaders and employees), as true agents in business, for the continued existence of a company (Sveiby 2001). Furu's value creation model builds on Sveiby's framework, but he recasts the classes of intangibles into three groups (Furu 2002):

Competence X Leadership & Organization X Motivation = Value Creation Potential

Figure 4 Furu's Value Creation Model

Furu's rationale for placing leadership with the organizational grouping may be related to the classical Simonesque concern about the self-interest of employees, which (under neoclassical economic thinking) can get in the way of maximizing utility or profit on behalf of the firm. Rather than having leadership overshadowed by organizational structure; for purposes of this thesis research, leadership has been moved from the central grouping within Furu's equation to a new classification of "Leadership and Motivation." This fine-tuning of an otherwise well-grounded conceptual breakthrough leads toward a continuum of intangible assets groups ranging from legal and registrable assets to organizational assets, plus competence assets and motivation assets as one moves further out on the horizontal axis of "soft assets."

Table 9 INTANGIBLE ASSET GROUPS (adapted from Furu 2008):

⇐ "harder"			"softer" ⇒
Legal or Registrable Assets	Organizational Assets	Competence Assets	Motivation Assets

These intangible asset groups are contained within a total firm assets "periodic chart" found in Chapter 6 and in a spreadsheet in the Appendix.

4.5 Systems of National Accounts/Classifications

In 1993, the World Bank, International Monetary Fund, Organization for Economic Cooperation and Development, United Nations and other international and regional bodies participated in the development of a System of National Accounts, which was released in 1993. The accounts were intended to measure, in an integrated and comprehensive way, a nation's production, income, capital, financial transactions and wealth. The modern notion of having a system of national accounts may have been given its impetus by John Maynard Keynes, in his 1940 article *How to pay for war?* (Vanoli 2005). Two economists, James Meade and Richard Stone (both of whom later won the Nobel prize) answered Keynes with research published in the the British *Economic Journal* – An Analysis of Sources of War Finance and Estimate of the National Income and Expenditure (Meade and Stone 1941). Their tables of income, output and expenditure encompass businesses, people, government and other factors that explicitly or implicitly include nearly all factor sources as understood by progressive economists at mid-century.

Unconnected with European research on national income, Wassily Leontief at Harvard published The Structure of the American Economy (1936) and An Empirical Application of Equilibrium Analysis (1941). On the strength of this research, the Bureau of Labor Statistics commissioned Leontief to lead a team to analyze inputs and outputs of the economy for broad government planning and programming purposes. But the efforts of this macro-economic statistical initiative did not survive the U.S. government budget cuts of the Korean War (Vanoli 2005). A fundamental resource on national macroeconomic accounting was published in 1958. Studenski's *The Income of Nations* delves into theory, methodology and country-by-country information in an encyclopedic manner, leaving no economic stones unturned for the period between the mid-1700s and the mid-1900s (Studenski 1958). Studenski's worldwide coverage and incisive explanations make his work (while somewhat dated) one of the most complete treatments of national accounting until Vanoli's *A History of National Accounting* was translated from the French original in 2005.

An equally ambitious effort was undertaken by Fritz Machlup in 1962 with his publication of *The Production and Distribution of Knowledge* (Machlup 1962). Machlup listed multiple reasons for studying the economics of knowledge, including 1) knowledge's increasing share of the national budget, 2) knowledge's social benefits, which exceed private benefits, 3) knowledge as associated with increases in productivity and economic growth, 4) knowledge's linkage to information and communication technologies, and 5) shifts in demand from physical labor to "brain workers." He also acknowledged that there are some insurmountable obstacles in a statistical analysis of the knowledge economy, because with production, input is allocated to bring forth valuable output, but with knowledge there is no physical output (in nearly all cases) and knowledge (again, for the most part) cannot be sold on the market. Machlup admitted that many of his estimates were speculative, but he claimed that those concerned about accuracy of statistical tables should not let their skepticism crowd out the message that he was trying to convey (Godin

2008). Perhaps Machlup's greatest contribution was to identify long-term education as an investment rather than a cost for organizations, given its return not only to individuals but to society at large.

Fifteen sectors and thirty industries were identified by Machlup as being "creators" to "transporters" of education. Those sectors are:

- Education
- Research and Development
- Printing and Publishing
- Information Machines
- Personal Services (including law, engineering, architectural, accounting and medical)
- Financial Services
- Photography and Phonography (recording industries)
- Stage, Podium and Screen
- Radio and Television
- Advertising
- Telecommunication Media
- Conventions
- Wholesale Agents
- Miscellaneous Business Services
- Government

Machlup also constructed a table that showed his concept of the use of ideas in the production process (Machlup 1962):

Table 10 Machlup's Flow of Ideas Through the Production Process

THE FLOW OF IDEAS THROUGH THE STAGES OF RESEARCH, INVENTION AND DEVELOPMENT TO APPLICATION (adapted from Machlup)

PROCESS

OUTPUT

Stage		Intangible	Tangible	Measurabl		Intangible	Measurable

				e			
I. Basic Research [Intended output: Formulas]		Scientific knowledge (old stock & output from 1-A Scientific problems & hunches (old stock & output from1-B, II-B and III-B	Scientists Technical aides Clerical Laboratories Materials, including fuel, power	Man-hours, payrolls, current & deflated Outlays, current and deflated Outlays per person		New scientific knowledge hypotheses and theories (A) New scientific problems and hunches (B) New practical problems and ideas (C)	Research papers Memoranda Formulas
II. Inventive Work (including minor improvements but excluding further development [Intended output: Sketches]		Scientific knowledge (old stock and output from 1-A) Scientific problems and hunches (old stock and output from II-A and III-A Practical problems and ideas (old stock and output from 1-C, II-C, III-C and IV-A	Scientists Inventors Engineers Technical aides Clerical Laboratories Materials, including fuel and power	Man-hours, payrolls, current and deflated Outlays, current and deflated Outlay per person		Raw inventions: technological recipes (A), such as patented inventions, patentable inventions, non-patentable inventions, minor improvements New scientific problems and hunches (B) New practical problems and ideas (C)	Patents Patent applications Technological papers and memoranda Papers and Memoranda

III. Development work [Intended output: Blueprints and sketches]		Scientific knowledge (old stock and output from 1-A) Technology (old stock and output from III-A) Practical Problems and ideas (old stock and output from I-C, II-C, III-C and IV-A) Raw inventions and improvements (old stock and output from II-A)	Scientists Engineers Technical aides Clerical Laboratories Materials, fuel and power Pilot plants	Man-hours, payrolls, current and deflated Outlays, current and deflated Outlays per person Investment		Developed inventions: blueprints, specifications and samples (A) New scientific problems and hunches (B) New practical problems and ideas (C)	Blueprints and specifications
IV. New-type plant construction [Intended output: New-type plant		Developed inventions (output from III-A) Business Acumen and market forecasts Financial resources Enterprise (venturing)	Entrepreneurs Managers Financiers and bankers Builders and contractors Engineers Building materials Machines and tools	$ Investment in new-type plant		New practical problems and ideas (A)	New-type plant producing: Novel products Better products Cheaper products

The United Nations issued its first System of National Accounts (SNA) in 1953 as a conceptual framework for compiling worldwide data on gross product, investment, capital transactions, government expenditure and foreign trade. The SNA attempts to set a standard for the measurement of market economies, however it cannot overcome differences in national accounts data (some governments keep good statistics; others are guesstimates). The SNA includes the following accounts for nations participating in the data pool (UNSTATS 2008):

- Production Account (components of gross output)
- Primary Distribution of Income Account (incomes generated by production)
- Transfers Account (includes social spending)
- Household Expenditure Account
- Capital Account
- Domestic Financial Transactions Account
- Changes in Asset Values Account
- Assets and Liabilities Account (balance sheet)
- External Transactions Account

A draft revision of the UN's 1993 SNA has been published, and the SNA's authors have tried to overcome criticisms that the 1993 SNA failed to account for gray markets, stock options and environmental externalities. Others have criticized the SNA as being biased against the poor and working women, because it does not account for the value of voluntary work and unpaid labor, such as for unpaid housekeeping and child care, and UN economists suggest that estimates could be made for the value of this labor based on market rates multiplied by population and occupation data, rather than direct accounting. An additional problem that has been identified is the so-called "Solow paradox," which says that if computers are so important in market economies, then why didn't their effects show up in productivity statistics? (Moulton 2003).

The long-standing problem of the treatment of intangible assets in the SNA has attained a new urgency in the so-called new economy, according to Youngman (2003). Some argue that we cannot capture such concepts as knowledge because it has no natural limit, no natural unit and no countable stock. But if the SNA is supposed to give a systematic view of economic reality, economists and statisticians are now saying that the SNA, while laudable in scope, is actually only giving a picture of part of the economy Youngman points out that our national economic measurement systems are mis-aligned with today's economic realities, because national accounts do not embrace the productive process of knowledge, information, creation and design in their underlying logics. No longer is it sufficient to trace the investment in physical capital and the hours worked by labor to track change (Youngman 2003). The stock of knowledge and skills possessed by persons and within companies is large and makes a major contribution to production, but neither intellectual capital nor intangible capital formation is properly recognized in national accounting (Hill and Youngman 2003). The European Commission concluded at its EU Intangibles Conferences that existing the existing measures are crude substitutes for intangible statistics, which need to be divided into skills, talents, stimulation of ideas, creations and scientific breakthroughs.

The eminent John Stuart Mill argued that, in principle, human capital ought to be included in the measurement of wealth. "The skill and the energy and perseverance of the artisans of the country are reckoned part of its wealth, no less that their tools and machinery" (Mill 1848). Hill noted that it is striking how many 19th and 20th century economists subordinated flow concepts, such as production or generation of income (which would include multiple human activities), to stock in the form of basic material wealth (Hill 1999). Services cannot be placed into stock inventory because their production and consumption are simultaneous, whereas goods must be produced before they are consumed. For classical economists, material goods became associated with wealth, and immaterial products were thought to "perish on the instant of their creation" (Hicks 1942).

Hence, there is difficulty in establishing a classification of knowledge-based products (goods and services) and then finding a unit of measure to capture knowledge-based values. Knowledge is different from conventional durable goods products, because it can be sold or given away, yet still retained by its original owner. Indicators of knowledge flows include transmissions of data but also contracts, wherein one entity agrees to deliver a good or service to another entity for some consideration (Gault 2005). Reliance on reductionist data points, such as only looking at hard measures of tangible goods, causes inadequate levels of data to reach decision-makers, says Youngman (2003). Due to the need for better economic data, a range of statistics (including those that could incorporate financial and non-financial measures), would help to describe an integrated sphere of economic, social and personal spheres. Time use, for example, may be a better technique to show working relationships and formal processes than trying to reduce the value of specific intangible assets to dollars. Assumptions of current national accounts – such as inclusion of only legacy sectoral groupings and neglect of non-material flows – have their roots in an industrial economy of decades past (Youngman 2003).

Youngman's critique of national accounts is directed toward his native United Kingdom economic statistics, but the same issues are prevalent in the United States. The old SIC code system, which emerged out of a Roosevelt administration initiative in 1934, was based on an economy that was dominated by extractive and manufacturing industries (Chwat and Beard 1994). Measures of the "establishments" in the SIC Code were shown by annual production (output) and gross labor inputs. The SIC did a fine job in describing and detailing the footwear manufacturing industry, but failed to recognize many firms arising out of the information age (Ambler 1998). Despite Ambler's glowing anticipatory article about the new North American Industry Classification System (NAICS, rhymes with stakes), the new system (instituted in 2002, and updated in 2007) continues the employment/payroll and output-oriented bias of the old SIC system. On the other hand, the NAICS did add nine new service sectors with 250 service industries, in a long overdue compilation and consolidation to better reflect the North American economies of the 21st century. Each establishment is classified according to its production characteristics, which helps to mesh NAICS two-digit industries with the value logic production model developed by Stabell and Fjeldstad (1998). But the meshing is incomplete, due to incomplete understanding on the part of Census Bureau economists and statisticians of the differences among Thompsonian "long-linked," "intensive," or "mediating" functions of firms, or of Stabellian/Fjeldstadian distinctions based on the firm's management focus of "products," "projects," or "networks."

Table 11 NAICS Two-Digit Codes for Major Industry Sectors

The North American Industrial Classification System contains the following industry groups at the "two-digit" level (Census Dept 2007):

11	Agriculture, Forestry, Fishing and Hunting	53	Real Estate, and Rental and Leasing
21	Mining, Quarrying, and Oil and Gas Extraction	54	Professional, Scientific and Technical Services
22	Utilities	55	Management of Companies and Enterprises
23	Construction	56	Administrative and Support, and Waste Management and Remediation Services
31 - 33	Manufacturing	61	Educational Services
42	Wholesale Trade	62	Health Care and Social Assistance
44 - 45	Retail Trade	71	Arts, Entertainment and Recreation
48 - 49	Transportation and Warehousing	72	Accommodation and Food Services
51	Information	81	Other Services (except Public Administration
52	Finance and Insurance	92	Public Administration

Official government definitions of the activities of construction NAICS 23) and architectural and engineering firms (found within NAICS 54) will be discussed in Section 4.7 of this Chapter. In addition to the NAICS project, the Bureau of the Census has been developing a North American Product Classification System (NAPCS) that categorizes industries based on the demand side for products and services. This demand-side categorization is not industry-of-origin based, but rather seen from a consumption-centric hierarchy that has focused on the NAICS service sectors from 48 to 81, which will support statistical research into competition among goods and services, market share and related concerns. True understanding of an economy cannot be gained merely by perusing production and productivity of all establishments within a nation. Additionally, one must look at the dynamic interaction between forces such as accumulation of human and physical capital, technical change and institutional change. Nadiri recommends delving into not only conventional inputs, but non-traditional inputs such as education, and resource reallocation in the face of technological and structural change within the economic system (Nadiri 1972). It is through this prism that one should look at the US System of National Accounts.

From a US national perspective, balance sheet accounts produced by the Federal Reserve Board and productivity statistics produced by the Bureau of Labor Statistics are among the best in the world, but they are not comprehensive or fully integrated (Jorgenson et al 2006). The accounts have been concentrating on issues of Keynesian fiscal policy rather than sources of growth, and therefore have a bias toward expenditure and income flows rather than capital inputs and capital stocks. What is needed is the development of an expanded set of satellite accounts that includes Research and Development and other intangibles, plus human capital and natural resources (Jorgenson et al 2006). Although a wide range of productive activities are worthy of inclusion in national accounts, Abraham and Mackie suggest five areas for measurement in order to accommodate most of the missing asset activities: investments in formal education and stock of skill capital, investments in health and stock of health capital, selected activities I non-profit and governmental sectors, environmental assets and services and production within household settings (Abraham and Mackie 2006).

An especially important non-market inputs measurement was put into place in 2003. The American Time Use Survey (ATUS) attempts to provide data on a wide variety of productive activities that are currently beyond the commercial markets – that is, time and/or work devoted to non-market production. Some have recommended the application of Reid's third-party criterion as a way to define outputs of the non-market economy, which would value the output as if someone in the market had produced the output for the individual (Reid 1934). A clearer definition of capital is needed, argues Hulten, since it is simultaneously a stock of inventories and productive assets held by producers and a stock of wealth held by consumers (Hulten 2006). For statistical information about capital stocks and flows to be meaningful across industries and across the national economy, there needs to be consistency in asset data collection and reporting at both the micro and macro level. Ideally, the US business surveys or required SEC reports would require detailed asset counts and measures to overcome the weak link in asset growth/decline and productivity measures by industry (Becker, Haltiwanger et al 2006). The Annual Capital Expenditure Survey (ACES) conducted by the Bureau of Economic Analysis currently falls well short of reasonable reliability, because it regards some industries as "inherently secondary," including engineering, accounting, research and management services (Jorgenson et al 2006).

4.6 Systems of Firm Accounts/Classifications

Perhaps thinking that their *expose* would influence changes in accounting the way that Fuller's *The Cliff Dwellers* helped usher in safety changes in high rise buildings a century earlier, Johnson and Kaplan used a title inspired by Milton in their *Relevance Lost – The Rise and Fall of Management Accounting* (Johnson and Kaplan 1987). Despite their rather scathing indictment of the accounting profession, the book sold well in management circles, but did not achieve the goal of shaking financial accounting out of its mid-20th century lethargy. Part of the problem stems from accounting's short-term focus on profits, rather than long-term adequacy of margins, which would impel firms to pay attention to strategy and adaptation. Another part of the problem is the facile derivation of traditional asset levels from income statements that do not adequately separate or allocate current expenses and long-term investments, particularly when it comes to non-physical and non-financial assets.

Johnson and Kaplan begin their diatribe by stating that financial accounting's reporting system is too late, too aggregated and too distorted to be relevant for management's planning and control decisions. And financial managers, relying exclusively on periodic financial statements for their view of the firm, become isolated from real value-creating operations of the organization (Johnson and Kaplan 1987). The two professors reserve an entire chapter for the ills of over-reliance upon direct labor costs as the means to allocate overhead, at the expense of ignoring the soaring costs of overhead personnel and budgets. When direct labor becomes too expensive in a global economy, the firm's financial management recommends transferring production activities to low labor cost locales; but the net result in product cost is relatively minor, due to the increase in home office overhead needed to manage the far-flung sources of direct labor (Johnson and Kaplan 1987). This is an unintended consequence of exporting capital rather than goods (see

Chapter 2, Section 2.3 for a brief discussion of David Ricardo and Herman Daly's views about competitive advantage and exportation of goods or capital).

Closer to home; by reading financial statements based on direct labor costs, managers are tempted to contract for the making of components or sub-assemblies, rather than making the objects in-house. But cost of product is not just driven by direct labor but also overhead, so outsourcing only saves a fraction and the company loses a core competency. Another issue related to short-term financial reports is the tying of management compensation to short-term results rather than long-range competitiveness. At the least, this approach is a serious disincentive to management objectivity (Johnson and Kaplan 1987). Alternatively, by using quantitative but non-dollars-based indicators, business leaders can return to operations-based measures that were the origin of management accounting systems. Nineteenth century railroads and textile manufacturing firms knew that cost-per-ton-mile and cost-per-yard of raw goods to finished product were clear summary benchmarks, and meaningful to management and investors alike; whereas earnings per share and short-term net income growth were once-removed abstractions from the business at hand.

Incomplete financial accounting systems, with their stilted and narrow view of the total firm, will not in and of themselves lead to organizational failure. But they are symptomatic of a broader influenza facing organizations from relying too heavily on myopic and short term financial data while ignoring market realities. If consumers no longer want 15 mpg V-8 powered rear-wheel-drive automobiles from General Motors; or facility owners no longer want to go through a year-long design exploration with their architect or engineer before beginning construction on their new office/hotel complex; what is the value proposition of the current production cycle and its output if buyers are deserting those models for ones that better meet their needs? Companies need to know the total cost of acquiring or developing *resources* – material, capital, people and technology – plus the cost of transforming these resources into final products and services (Johnson and Kaplan 1987). This observation leads the student of the theory of the firm toward resource-based theory; that is, not consigned to a closed-system neoclassical production-based theory simply composed of traditional fixed assets and monetary resources, but moving to one of fixed, financial, capabilities, processes, information, knowledge and other factors controlled by the firm (Barney 1991).

Resource-based theory relies on an assumption that firms gravitate toward growth by utilizing all of the firm's available resources, including physical, financial, organizational and intellectual (Anantadjaya 2008). Management recognizes that there are productive and unproductive assets within the firm, and part of their charge is to mobilize unproductive or under-performing resources that are controlled or influenced in the firm's production process. Management also is cognizant of the differences between tangible and intangible resources, which require different managerial emphases given their varying characteristics. Monetary and physical resources are both additive in nature, wherein if management uses these assets, there are less left to use; if investment is made in these tangibles, there will be more available for use (Roos et al 2005). Tangible assets are rival assets; that is, if an asset is specifically deployed in a particular time and space, it cannot be used elsewhere.

Intangible assets are in general, non-rival, and can be deployed at the same time and in multiple uses, and are consequentially, scalable (repetitive applications without depleting their usefulness). Physical assets are limited by diminishing returns to scale, whereas intangibles (with largely sunk cost and negligible marginal cost) have increasing returns to scale (Lev 2001). Well-defined property rights of physical and financial assets enable owners to effectively exclude non-owners from accessing benefits through direct control of these tangible assets. By contrast, intangible assets can be expropriated by non-owners, often without legal penalties through leakage or spillover due because property rights are imperfectly defined, rarely enforced, unclear or non-existent. This partial excludability (fuzzy property rights) creates unique managerial and policy challenges. If intangible ownership is strict and rigid, society may lose benefits of innovation and dissemination of new ideas and products. If there are no protections of intangible assets for the firm or individual entity, the potential profit motive of innovation is disincentivized (Lev 2001). A traditional advantage of physical assets is their market exchange value. Because intangible assets are often firm-specific, these assets are relatively non-tradable because they may have little market value outside of a going concern. It is also rather difficult to write complete contracts based on incomplete definitions or specifications of expected outcomes from intangible assets, making this class of assets more risky than physical assets. Industry classifications are constituted by researchers for a variety of purposes and may reflect characteristics of markets, technologies, factor inputs or production processes.

Beginning with Carl Menger's distinction between output by firms of "first order," "second order" and "higher orders" of goods, economists and accountants have been able to distinguish between intermediate and end-use categories of output (Menger 1871). One of the most popular taxonomies of firms is based on sectoral technological trajectories, characterized by science-based firms, production intensive firms or supplier dominated firms. Pavitt was concerned with finding significant innovations by UK firms in the period 1945 to 1975 to explain patterns of change (Pavitt 1984). Another contemporary determined that factor endowments were the key to firm specialization, separating classes of companies into those emphasizing Ricardo goods (resource intensive); produced goods (either capital or labor intensive), and high technology goods (Lawrence 1984). Neven improved upon the earlier classifications by using statistical cluster techniques to more accurately segment firms by four factor intensities: labor intensity (shares of wages in value added), capital intensity (share of investment in value added), wage levels (average compensation per worker) and human capital (share of blue collar workers per total number of employees at the firm) (Neven 1994). Neven then sets out five industry clusters based on his collected data: 1) labor intensive with high wage and high proportion of white collar workers, 2) labor intensive with high wage but low capital investment, 3) labor intensive with low wage, low investment and a high share of unskilled labor, 4) capital intensive, low wage and a high share of blue collar workers, and 5) capital intensive with high share of white collar workers (Peneder 2001).

Peneder points out that a significant drawback in industry taxonomies is their strong bias toward the manufacturing sector. Of the few classification systems that incorporate manufacturing and production, the Singelmann typology of producer services, distributive services, personal services and social services begins to tie together all sectors of the economy (Singelmann 1979). Two later taxonomies by Peneder attempted to categorize classes of firms according to intangible investments and human resources, achieving disaggregations that looked at sources of labor and capital intensity, and employment shares by classes of workers, respectively (Peneder 2001). For purposes of this research project, an industry classification system based on how assets are deployed in a firm's production/transformation process holds the promise of illuminating how dynamic assets further going concern value and longevity of the enterprise. Given the objectives of this study, the industry classification scheme offered by Stabell and Fjeldstad (see Section 2.4 of Chapter 2) meets Peneder's tests for industry classifications – the typology must be based on start of the art observations about real-life phenomena; it must be up to date with current international economic thinking and it must be useful for different levels of industry disaggregation (Stabell and Fjeldstad 1998; Peneder 2001).

In addition to the benefit of having industry classifications in order to progress from mere observation to a more systematic scientific inquiry about overall classes of firms, a number of researchers have also devised methods and frameworks for management accounting at the individual firm level. Numerous management accounting assessment and valuation models have been proposed, and a few of the more interesting conceptual methodologies (for assessing either firm assets or asset values) are summarized here in three categories, based upon their measurement emphasis: financial ratio-based models, intellectual capital based models and holistic firm-based models.

Financial Ratio-Based Models – Among the commonly used financial ratio-based models are economic-value added, market value-added and Tobin's Q ratio. *Economic value-added* (EVA) is the difference between a company's net operating income after taxes and its cost of capital of both equity and debt. Van Den Berg criticizes economic value-added on a number of fronts: EVA is difficult to calculate because it requires hundreds of adjustments due to traditional accounting's view of intellectual capital as an expense rather than an investment; it is based on historical events and historical data; and it measures stocks rather than flows (Van Den Berg 2003). *Market value added* (MVA) is the difference in the market value of a company (both equity and debt) and capital that lenders and shareholders have entrusted to it over the years in form of loans, retained earnings and investor capital. When the difference between the cash that investors have put into the business since start-up and the present value of the investment based on selling of shares is maximized, wealth of the company's shareholders is emphasized (Bontis 1999). Similar to EVA, MVA focuses on historic data and is concentrated on the value of company stock. *Tobin's Q ratio* is the value of capital relative to its replacement cost, rather than market to book value. Alan Greenspan cited the measure as reflective of the value in investments in technology and human capital of firm's with high Tobin's Q ratios (Stewart 1997). While the ratio is another useful measure for financial purposes, it once again relies on look-back data tied to changes in stock rather than flows (Van Den Berg 2003).

Intellectual Capital Based Models – The *balanced scorecard approach* of Kaplan and Norton was borne out of the recognition that a company must mobilize and exploit its intangible assets to realize its strategic vision. In their efforts to build long range competitive capabilities, managers were "colliding with the immovable object" of historical cost-based accounting (Kaplan and Norton 1996). The balanced scorecard suggest that firms be viewed from four perspectives – customer, internal business processes, learning and growth and financial – as a way to balance between external measures for shareholders and internal measures for innovation, learning and growth. The balanced scorecard collects results of human activity over time and therefore has historic data, but due to its flexible format, can incorporate both stock and flow measures. The *Skandia IC Navigator* was created by Leif Edvinsson to attempt to measure all of the company's intangible assets. The comprehensive format "…emboldened others to look beyond traditional assumptions of what creates value for organizations" (Bontis 2001). Although a historical report of firm activities, the IC Navigator includes plows previously untilled ground, including data from financial, customer, process, renewal and human aspects of the company. And while incorporating many stock measures, some financial flow metrics such as expenses, profit and return on assets are included and related to number of employees (Van Den Berg 2003). Sveiby's *Intangible Asset Monitor* is another of the late 1990s pragmatic attempts to go beyond the wooden quality of traditional financial statements and capture knowledge capital, internal structural assets and external structural assets. The IC Monitor is a historical document that reports on financial and non-financial assets, but is primarily focused on such factors as sales per staff or value added per employee (Sveiby 1997).

Holistic Tangible and Intangible Asset Models – Since the beginning of the 21st century, scholars have been inching gingerly into asset assessment and valuation models that try to merge tangible and intangible resources. Among the first to propose a holistic model was Goran Roos, with an *IC Index* based on relationship capital, human capital, infrastructure capital and innovation capital (Roos et al 2000). Although laudable for its reach and scope, the IC Index uses surrogates (percentages of relevance for particular assets) in an attempt to make all "indices" additive, which is unrealistic given the differences in intent and time value of the resources. Further, the Index is based on historical data and measures stock at a given point in time, which is no appreciable improvement upon traditional financial capital approaches. A second holistic approach to asset assessment and valuation is *Real Option Theory*, developed by Bowman and Moskowitz, among others (Bowman and Moskowitz 1997). A real option is the investment in physical assets, human competence and organizational capabilities that provide the opportunities to respond to future contingent events (Kogut and Kulatilaka 2001). Real option theory points to the future in an attempt to build a plausible financial future for managers, using projections of both stocks and flows of the firm.

Resource based theory seems to encourage a total assets view with special emphasis on previously unreported assets. As mentioned earlier in this section, numerous (perhaps more than 40) asset data collection, assessment, valuation or efficiency measuring systems have been introduced since the late 1980s. It is not the intent of this work to review all of those efforts, but instead to show a few of the useful steps toward a generally-accepted guideline. Since 2000, there have been a few serious and in-depth frameworks proposed, although none have garnered universal acclaim. Lev's Intangibles Scorecard was useful for determining the monetary value of intellectual capital (Hurwitz 2002). Similarly, the Weightless Wealth Tool by Andriessen demonstrated a method of valuing groups of intangibles (Andriesson 2004). The Intellectual Capital Efficiency method (or ICE) as developed by Pulic contributes to the valuation of intellectual capital for developing figures for the financial balance sheet, but cannot be used for supporting company investment decisions (Pulic 2004). Meritum Guidelines are a comprehensive framework for use by any type of organization in constructing an intellectual capital report about organizational abilities and resources but are not intended to provide monetary valuations (Lonnqvist et al 2005). A related system is entitled the "Danish Guidelines," which focus on organizational knowledge management strategy and performance measures as well as a communication tool for stakeholders (Mouritsen et al 2003). Selected intellectual capital assessment and valuation models introduced since 2000 are discussed in Section 4.9.

4.7 Indicators of Intangible Asset Stocks and Flows within A/E/C Organizations – A Proposed Organizing Scheme

Within an architectural, engineering or construction firm, stocks are either residing in a "reservoir" within the system or moving through the system like "tributaries to a river" when internal actions "enable" flow (Boudreau 2002). Much has been researched and written about the traditional physical and financial stocks of construction industry enterprises, hence this section will concentrate on intangible and knowledge asset stocks and flows. As delineated in Section 2.6, an architectural or engineering firm functions as a value shop and a construction firm operates as a composite of value chain and value shop organization. Subsequently, design firms and construction firms emphasize a number of different asset categories and factor inputs to accomplish their respective missions.

Common definitions of the architectural, engineering and construction sectors are found in the North American Industrial Classification System (NAICS 2002, 2007). A/E Firms are found in the two digit Sector 54 – Professional, Scientific and Technical Services, wherein "establishments are engaged in processes where human capital is the major input…with production processes that are almost wholly dependent on worker skills" (NAICS 2007).

Although Architectural, Engineering and Related Services are listed at the four digit (5413) level, definitions are found at the six digit establishment level. "The industry [of 541310

Architectural Services] comprises establishments primarily engaged in planning and designing residential, institutional, leisure, commercial and industrial buildings and structures by applying knowledge of design, construction procedures, zoning regulations, building codes and building materials" (NAICS 2007). "The Engineering Services Industry [541330] comprises establishments primarily engaged in applying physical laws and principles of engineering in the design, development and utilization of machines, materials, instruments, structures, processes and systems. The assignments undertaken by these establishments may involve any of the following activities: provision of advice, preparation of feasibility studies, preparation of preliminary and final plans and designs, provision of technical services during the construction or installation phase, inspection and evaluation of engineering projects, and related services" (NAICS 2007). Additional professional services directly related to A/E services in the NAICS are Landscape Architectural Services (541320), Surveying and Mapping (541370), Testing Laboratories (541380), and Environmental Consulting (541620).

Construction Firms are classified by the Bureau of Economic Analysis in Sector 23, which is composed of establishments that are primarily engaged in the construction of buildings or engineering projects (e.g., highways and utility systems). Construction work accomplished by these establishments may include new work, additions, alternations, or maintenance and repairs. Activities of these firms a normally managed at a fixed place of business, but the actual physical construction work is performed at multiple project sites. Production responsibilities for establishments in this sector are usually specified in 1) contracts with owners of construction projects (prime contracts) or 2) contracts with other construction establishments (subcontracts) (NAICS 2007). Key residential construction subsectors include 236115 New Single Family Housing Construction, 236116 New Multifamily Housing Construction and 236117 New Housing Operative Builders (operative builders are commonly known as developers). Other key construction subsectors are 236210 Industrial Building Construction, 236220 Commercial and Institutional Building Construction, 237110 Water and Sewer Line Construction, 237120 Oil and Gas Pipeline Construction, 237130 Power and Communication Line Construction, 237310 Highway, Street and Bridge Construction, and 237990 Other Heavy and Civil

Engineering Construction (which may include marine and dredging, rail and transit, nuclear waste disposal, etc.) (NAICS 2007). While the classifications of most general contracting and construction management firms are based upon facility and structure types, specialty trade contractors are predominantly classified according to significant material handled and installed in the construction. Among these are 238110 Poured Concrete Foundation and Structure Contractors, 238120 Structural Steel and Precast Concrete Contractors, 238140 Masonry Contractors, 238150 Glass and Glazing Contractors, and so on through all the major material sections that may be found in a project specification. The NAICS are based on a supply side, rather than a demand side view of major North American industries.

Organizational and knowledge assets reflect both the intensity and nature of interactions internally (within the firm) and externally to non-firm stakeholders (Nonaka and Takeuchi 1995). The notion of knowledge asset creation appears to be particularly compatible with the project orientation of design services (Baark 2005). Knowledge flows in engineering firms may be expanded or acquired on a project-by-project basis, from customer interactions, from diverse members of the project team and through project research. However, during the design phase, the constructor's input to knowledge asset growth is often constrained due to government regulation (Baark 2001). Group interaction is often a key to project knowledge assets, and this dynamic can be helped or hindered by the "collective mind" that exists in organizations (Weick 2001). Whelton proposes a spiral development model for project definition that replicates a shared process model wherein iterative development of solutions results in group learning and asset enhancements for both the design team and the client (Whelton 2002).

The 2004 CLEVER framework was a UK-based effort to develop a process framework looking at organizational and cultural implications of knowledge-based design and construction businesses (Siemienicuch 2004). The aim of the work was to create a framework for knowledge management and sharing in a multi-project environment using a supply chain context. The CLEVER process template had a number of shortcomings, including testing participants to see if their organization exhibited a readiness for knowledge learning management, followed by implementation of how to understand and translate those knowledge assets from one community to another. In the words of the chief researcher, "…there is little point in planting roses in the desert unless it had been well-watered and manured" (Siemienicuch 2004).

Fong maintains that the construction industry is an information rich and knowledge rich industry hampered by extreme fragmentation. Due to the tacit nature of in-depth knowledge, only a very small percentage of what a [designer or builder] knows can be turned codified or turned into explicit information for others (Fong and Chu 2006). Organizational culture may be more important to knowledge sharing than approach or commitment to knowledge management, because a lack of time (due to project pressures) will prevent participants from sharing knowledge, even when the technology available is helpful to transmission of lessons learned (McDermott and O'Dell 2001). Tacit knowledge is difficult to explicate – hoarders keep it in their heads – so only 2 percent of information gets written down (Hickens 2000). Effective management of knowledge assets requires hybrid and blended solutions involving people, processes and technology, and people-to-people techniques such as mentoring, coaching and apprenticeship are ways to transfer knowledge resources effectively (Fong and Chu 2006).

A large proportion of competitive assets of professional designers is based on intangible knowledge inputs learned through practice and embodied in the expertise employed by the firm. Resources mobilized in the process of analytic design depend on codified data and routines (such as finite element analysis and building code requirements) which require tacit knowledge that cannot be easily expropriated via intellectual property rights (Baark 2006). The complexity and fragmentation of the design and construction process creates a configuration that embodies compromise and synthesis of many strands of knowledge, eventually made explicit through plans, building processes and actual facilities (Gann and Salter 2000).

Another distinction of professional service firms is the clear separation of commodity product from time-based professional expertise. The dichotomies between manufacturing and services are well-established, but differences between general services and professional services are also important. Typical professional service firms include accountants, medical practitioners, financial analysts, architects, business consultants and advisors, and professional engineers. With professional services, deliverables to the customer are based on skill or knowledge rather than a product such as food, accommodation or transportation (Rouse et al 2006). The point of his University of Auckland study is that both inputs and production cycles of professional service firms are time-based and labor-dominated, making it more difficult to disentangle intangible inputs from activities.

Both design and construction are project-driven, and researchers have identified three groupings of intangible assets that are specific to project-centric firms. First, the project management knowledge base includes the theory, techniques and technologies for managing the execution of projects; second, the project-specific technical knowledge base which contains the DNA of the structure and all of its related systems; and third, the organizational data base, which represents information and know-how about the principal parties organizations and the wider environment in which the project resides (Conroy and Soltan 1998). To properly capture project-based knowledge assets, a template must be developed with an overall systems perspective, rather than a group of ad-hoc pieces, and the system much cater to a wide range of company and project types, sizes and disciplines (Kazi 2005). It is with Kazi's instructions for best practices and principles for intangible asset management systems that outlines of static (stocks) and dynamic (flows) of intangible asset accounts are proposed and shown in tabular form in Chapter 5, based on and expanded from the value creation model of Furu (2008):

It is important to acknowledge that modern production theory, also known as value logic theory, forms the theoretical lens for this research. Value logic theory is based on the seminal work of Thompson (1967) and Stabell and Fjeldstad (1998). The notion of a theoretical lens or perspective originated from a definition of theoretical rationale, which is a systematic argument that helps to explain phenomena that occur in the world (Labovitz and Hagedorn 1971). Theories differ in their breadth of coverage – value logic theory is a macro-level theory affecting entire industries, whereas the theory of accounting applied to an individual organization is a micro-level theory (Newman 2000). In this research paper, the asset-based micro-level theory of accounting will nest within or be overlaid by the macro-level value logic theory. Groupings of concepts at the meso-level, as shown in the next chart, are useful means of linking the macro-level to the micro-level.

Table 12 INPUTS, PRODUCTION VALUE LOGIC AND OUTPUTS AT VARIOUS LEVELS

LEVEL	ERA	APPLIED TO	INPUTS	TRANSFORMATION	OUTPUTS
meta-level	Traditional 1800 - 1950	World Economy	The Big Three – *Land* *Labor* *Capital*	Production Cycle from Raw Goods to Semi-Finished or Finished Goods	Extracted or Manufactured Goods
macro-level	Recent 1950 - 2000	National Economies	The Five Ms – *Machines* *Money* *Minds* *Motivation* *Milieu* (macro-environment)	Business Process Value Creation, Including Value Chain	Primary Commodities Secondary Commodities Services – Hard Deliverables Services – Soft Deliverables
meso-level (industry) micro-level (individual firm)	Current 2000+	National Industries, such as A/E/C	Seven Asset Classes: *Physical Natural* *Physical Produced* *Financial* *Legal and Registrable* *Organizational* *Competence* *Motivational*	Value Chain Value Shop Value Network Value Composite	Goods and Services for the Built and Natural Environment

Following theoretical and conceptual precedent, intangible assets of firms may consist of four constructs: intellectual property (herein entitled legal and registrable assets), organizational assets, competence assets and motivational assets (Williamson 1985; Barney 1991; Hall 1992; Welbourne and Wright 1997; Becker and Huselid 1998; Spanos and Lioukas 2001; Grant 2002; and Fahy 2002). Because valuable legal and registrable assets are either accounted for on a firm's balance sheets or in explicit footnotes, this research concentrates on the remaining three constructs and their respective measures.

Assessing the profile of core resources and capabilities of firms is one of the most compelling challenges for scholars and practitioners who are interested in the resource-based view (Carmeli 2004). Because a firm is perceived as a bundle of resources, the accumulation and deployment of physical, financial and organizational assets are the basis for executing the firm's goals (Penrose 1959). Different firms possess different bundles of productive resources, because assets can be relatively immobile, inelastic in supply, or costly to copy; hence there is at least some degree of heterogeneity among firms (Barney 1997). Bundles of assets in the form of competencies are related and linked to one another, and relationships among sets of complementary competencies either expand or contract the strategic options available to the firm (Barney 1994). Rumelt developed a list of "isolating mechanisms" that protect a firm from imitation and preserve rent streams, including property rights to scarce assets, customer switching costs, reputation, channel crowding and producer learning (Rumelt 1987). A dynamic asset model of a firm would, nevertheless, still depend on its "resource endowment" as a starting point for competitive positioning (Peteraf 1993).

In Chapter 5, a series of potential indicators of intangible asset use within firms will be explored; followed in Chapter 7 with the formulation of pragmatic constructs built from selected variables.

4.8 Reporting of Knowledge/Intangible/Dynamic Assets

In 1999, Fahy and Smithee proposed a classification of a firm's resource pool incorporating tangible assets, intangible assets and capabilities (Fahey and Smithee 1999). The table is reproduced here:

Table 13 THE FIRM'S RESOURCE BUNDLE (Fahey and Smithee 1999)

AUTHOR	TANGIBLE ASSETS	INTANGIBLE ASSETS	CAPABILITIES
Wernerfelt 1989	Fixed assets	Blueprints	Cultures
Hall 1992		Intangible assets	Intangible capabilities
Hall 1993		Assets	Competencies
Prahalad & Hamel		Core Competencies	

1990			
Itami 1987	Visible assets		Invisible assets
Amit & Shoemaker 1993			Intermediate goods
Hofer & Schendel 1978			Distinctive competencies
Hitt & Ireland 1978			Distinct competencies
Irvin & Michaels 1989			Core skills

The defining characteristics of tangible assets are that they are relatively weak at resisting duplication efforts by competitors, and although plant and land may be geographically immobile, they are relatively imitable and substitutable (Grant 2002). Intangible assets can be relatively resistant to duplication efforts by competitors. Intellectual property has legal protection and databases and networks are asset stocks of relative complexity and specificity, and therefore provide barriers to imitation and substitution in the short run (Dierickx and Cool 1989). The fundamental management task in firms is to deploy resources and assets to gain industry success or to create new assets that generate a Schempeterian-type revolution within the specific industry (Fahy and Smithee 1999).

The value of reporting through a generally-accepted classification system is associated with the system's ability to function as a heuristic device (Grojer 1999). Four characteristics of a good classification system for reporting, according to the American Accounting Association, are that the system must be exhaustive (able to show a complete picture of the phenomena), exclusive (no object can be assigned to more than one class), consistent (terminology and definitions must be distinct and clear) and have hierarchical integrity (that is, maintain the relations between different classes up and down the degrees of granularity) (Roberts 1995). Grojer suggests that a workable intangible asset accounting scheme requires consideration of equity theory. Under traditional equity theory, the shareholder value would reign supreme, such as in today's accounting dogma. Under contemporary entity equity theory, the company has its own existence, and value to the business becomes a crucial concept. Intangible assets would be a critical part of the production function under entity equity theory. A third approach would be to consider external enterprise equity theory, where the welfare of all internal and external stakeholders would be introduced, and the concept of social accounting would be actualized (Grojer 1999). For purposes of this research, the middle concept of entity equity theory underpins the scope of the asset classes.

A foundational characteristic of a knowledge economy is where knowledge replaces labor and capital as a fundamental resource in production (Andriessen 2004). In an attempt to document this shift in thinking about factor inputs, intellectual assets research pioneer Karl-Erik Sveiby listed 28 different methods of determining intangible assets, including their strengths and weaknesses, in his recent historiography (Sveiby 2004). The more mature models incorporated a broader continuum of organizational assets, although traditional accounting and measurement systems have not absorbed the values of these inputs in a mainstream way (Freund 2005). The EU Prism Project charted the range of "assets of the 21st century enterprise" in this tabular format (Eustache 2003):

Table 14 EU PRISM Range of Assets

Tangible Assets Where Ownership is Clear and Enforceable	Rights that Can Be Bought, Sold, Stocked and Readily Traded in Disembodied Form and Generally Protected	Non-Price Factors of Competitive Advantage	Potentially Unique Competitive Factors that Are Within the Firm's Capabilities to Bring About
Hard Commodities			Soft and Difficult to Isolate
TANGIBLE ASSETS	**INTANGIBLE GOODS**	**INTANGIBLE COMPETENCIES**	**LATENT CAPABILITIES**
Physical Assets PP&E Inventory Other *Financial Assets* Cash & Equivalents Securities Investments	*Material Supply Contracts* *Licenses & Franchises* *Registrable IPR* Copyright or Patent Originals Trademarks Designs *Other IPR* Brands, Know-How	*Competency Map* Distinctive Competences Core Competences Routine Competences	*Capabilities* Leadership Workforce Calibre Organizational, Including Networks Market/Reputational Innovation/R&D in Process Corporate Renewal

	and Trade Secrets		

Published intellectual capital statements are rare documents, and there has been far more talk about possible benefits of such documents than of their actual content (Mouritsen et al 2001). There has been remarkably little attention to specific real-life measurement (metrics and indicators) of intellectual capital in the literature; rather, the discussion has centered on the classification of intangible resources Bukh et al 1999). Intangible asset statements, in the few instances where they have been published and available for external review, cannot be read as directly and easily as financial statements; because the financial statement is an institutionalized reading of liquidity, profitability and solidity, albeit through a purely financial prism (Mouritsen et al 2001). Some intangibles are already included on traditional financial statements, usually as line items in italics with disclamatory footnotes, or simply as footnotes. International accounting rules for reporting non-financial assets have been evolving slowly for the past 25 years. In the early 1990s, the EU SSAP22 (Accounting for Goodwill) and EU SSAP 13 (Accounting for R&D) came into force and were superseded by the Accounting Standards Board FRS10 in 1998. In 2005, the draft IAS38 added "intangible assets held for use in the production or supply of goods and service, for rental to others, or for administrative purposes" (Starovic 2004). Meeting the asset inclusion tests set forth by the Accounting Standards Board is still difficult: the asset must be separately identifiable, controlled, have a probability that future benefits specifically attributable to the asset will flow to the firm, and have a *cost* that can be reliably measured (emphasis added). The net effect chills the opportunity for many European firms to easily place intangibles in the traditional financial reports; and instead, publicly-traded firms file (under the Companies Act of 2003) an Operating and Financial Review that is supposed to contain a "dynamics of the business" section of risks, opportunities, events and uncertainties – in other words, management challenges and actions – that speak generally to the interplay of tangible and intangible assets of the company within a dynamic economy (Starovic and Marr 2005).

4.9 State of Current Research

A huge amount of research has been undertaken within the fields of intangible assets and intellectual capital during the past 20 years. The interest in these topics stems partially from the complexity of the concept, which includes the workings of systems and meta-systems at different levels of analysis. On one hand, it is the very challenge of understanding a complex dynamic system; on the other, it is the practical pursuit of qualifying and quantifying what is driving firm performance, which could help firms achieve their goals more effectively. An example of needed understanding at the subsystem level is the lack of explanatory value of financial statements for significant advances by firms in the area of innovation and creativity. Because traditional accounting methods do not adequately value a company's assets when the firm has assets that are predominantly intangible, new instruments of measuring and managing these inputs must be mobilized (Nielsen 2008). But much of the literature of the 1990s implied that intangible assets could be conceptualized and counted in a manner reminiscent of traditional accounting. But as Pike and others have pointed out, the virtual values of intangible assets and real money of the financial and physical assets cannot simply be added together (Pike et al 2001).

In Australia, a framework for reporting intangibles was developed modeled after the OECD outline consisting of seven areas: 1) information system architecture; 2) production and technology; 3) human resources; 4) organization and administration; 5) procurement; 6) distribution and 7) customer linkages. The authors insist that a number of expenditure items listed under the categories will be classified as investment in intangible assets, rather than expenses (Hunter et al 2005). Citing a figure of 13 percent of GDP is in intangible assets, Corrado et al outline a framework for measuring real output and productivity due to investment in intangibles. While recognizing the challenges inherent in generating the aggregate value of "new economy capital," the researchers submit that their results strongly suggest that intangible investments need to be included in the empirical accounting of factors determining economic growth (Corrado et al 2005). Among the missing pieces are knowledge about the expected service lives of physical and intangible assets, both of which have a direct bearing on future productivity.

Ghosh and Wu have researched whether intellectual capital is used in firm valuation and to what degree, and have concluded that the intangibles are definitively used in assessing firm value, but that intellectual assets are not included in calculations of short term performance (Ghosh and Wu 2007). Kohlbeck and Warfield studied how the impact of intangible assets affected equity valuations and abnormal earnings of banks, uncovering the importance of existing customer relationships, active mortgage services, credit card support and trust operations as unrecorded by valuable intangible assets (Kohlbeck and Warfield 2007). Andreou sought to unveil key business performance value drivers, and found that the research supported hypotheses about intangible valuation areas, including enterprise intelligence, leveraging of technology, customer intimacy and innovation capital (Andreou et al 2007). Vergauwen's research places a cautionary cloud over intellectual capital disclosure, citing the cost of gathering intangible asset data, the firm's unwillingness to provide transparency of inner resources or processes to competitors, federal or state regulatory barriers and auditor conservatism (Vergauwen et al 2007).

Recently, Cricelli and Grimaldi initiated a study of the dynamic view of knowledge using a stock and flow based methodology (Cricelli and Grimaldi 2008). While the research cited in this section broadens the scope and depth of the search for knowledge about intangible assets, no single project in the past four years attains the breadth of (previously mentioned) intangible resources study by Corrado, Roos and Galbreath (Corrado et al 2005; Roos 2005; Galbreath 2004). It is these more comprehensive investigations into the substance of firms' resources that inform and inspire the subject of this paper.

Table 15 General Classifications of "Hard" and "Soft" Assets and their Nomenclature

General Classifications of "Hard" and "Soft" Assets

Researcher and Year	*"Hard" Assets*	*"Soft" Assets*
Neoclassical Econ 1960s+	Fixed and Financial	Human
Sveiby; Edvinsson 1990s	Tangible	Intangible
Quah; Andreissen 1999	Weighted	Weightless
Daum 2002	Material	Immaterial
Courtney & Holtham 2003	Inanimate	Animate
Bragdon 2006	Non-Living	Living
Beard 2009	Corporeal	Volitional

"I suddenly realized that Keynes and all of the brilliant economics students in the room were interested in the behavior of commodities, while I was interested in the behavior of people." -- Peter F. Drucker in *The Ecological Vision* (1993)

"Money is simply a proxy for human effort." __ Karl-Erik Sveiby

CHAPTER 5 CURRENT & PROPOSED ASSET-BASED INDICATORS: RESOURCE-BASED FACTORS & PROPOSED CONCEPTUAL MODEL

5.1 Overview and Categorization of Tangible and Intangible Assets – Contributions and Shortcomings of Existing Concepts

The classical economists identified assets used in production as land, labor and capital. While these three iconic factor inputs are categorizations of Adam Smith's 18th century, a more contemporary compilation of asset groups is sanctioned under the US Generally Accepted Accounting Principles (GAAP 2008). Those tangible financial and physical asset categories recognized under this convention are:

- Current Assets – including cash (currency, bank deposits, money orders, checks) short term investments (usually securities), receivables, inventory and pre-paid expenses;
- Long Term Assets – including investments (bonds, common stocks, notes), land held for sale, special funds (e.g., sinking funds, pension funds), and investment shares in subsidiaries or affiliates; and
- Fixed Assets (also known as PPE) – including property (land, buildings), plant (machinery, tools, manufacturing lines), equipment e.g., (tools, furniture, IT hardware) and resources (e.g., timber, minerals).

To determine the existence of a traditional fixed or financial asset, accountants discern whether the asset has 1) discreteness (is the asset individually distinct and separable so that it may be properly measured), 2) observability (can the asset or effects of the asset be directly seen or touched), and 3) control (is the asset fully or partially owned and with the directorial dominance of the company or its management) (Blair and Wallman 2001). If resource-based theory says that firms are bundles of assets, how does one identify the rest of the assets at a firm's disposal? Only conventional tangible assets are readily apparent on the firm's balance sheet, and a few additional assets may be found in the narrative of the firm's annual report to investors. But the remainder of the assets, particularly organizational, knowledge and other so-called intangible assets, are hidden from the surface and kept off the balance sheet.

Conceptually, business scholars may be able to accept the existence of intangible assets if it is understood that capital, in whatever form it may take, creates value even if it does not possess instant value in and of itself. There are agents of production that are not primarily physical or financial; nevertheless, these agents are indispensable for enabling or improving the production process. Peter Drucker treated knowledge or intellectual capital as a distinct form of capital that could not be substituted for by traditional forms of capital, and recommended that both traditional and human capital should receive ongoing attention and investment by management (Drucker 1985).

Skandia was the first corporation to make a comprehensive effort toward identifying and measuring intangible assets, by building a system to collect data on knowledge assets in the late 1980's and subsequently issuing its first report to shareholders in the early 1990's (Bontis 2000). Edvinsson's Skandia Navigator organized an accounting taxonomy consisting of five areas of focus: financial, customer, process, renewal, development and human capital (Edvinsson 2008). The Skandia Report (1997) evolved to include 112 metrics documenting, for example, the number of PCs in the company versus the number of employees, training expense divided by administrative expense, the number of managers with advanced degrees and licenses/certifications, and number of days spent directly with customers. Sveiby, who was certainly influenced by the work at Skandia, devised a tangible assets system even further away from financial accounting. Sveiby believed that money should cease to be a proxy for human effort (wages), because money (as a secondary medium of exchange) failed to adequately represent the greater complexity of intangible concepts such as competence and stability that are built up over a long period of time (Sveiby 1997).

A widely accepted definition of asset, as published by the International Accounting Standards Board, states that "an asset is a resource controlled by an enterprise as a result of past events and from which future economic benefits are expected to flow to the enterprise" (IASB 2008). Tangible refers to the capability of being perceived by sense of touch, and of being capable of being appraised for an actual or approximate value (Lonnqvist 2002). Intangible refers to something that is unable to be touched, or something that cannot be precisely measured in strict monetary terms or directly assessed for financial value, and therefore may be somewhat abstract, such as customer goodwill (Lonnqvist 2002).

5.2 Introduction and Discussion of Seven Categories of "Corporeal" and "Volitional" Assets

Resource-based theory has gained much prominence in the literature since the early 1990s, and has been gained standing as an alternative to industrial organization theory as an explanation of why some firms perform better than others. Foss cautions, however, that it would be premature to abandon tangible assets as factor inputs, since these have been seen as influencing firm performance since the time of Adam Smith (Foss 1997). To avoid abandoning the old for the new, one proposition suggested herein would be to blend intangible and tangible assets into an amalgam of factor inputs, which would mirror the business practices of individual firms. There is some anecdotal evidence that, to a large degree, reluctance to embrace "intangible assets" by accountants in the A/E/C industry stems from a skepticism about the word *intangible* being applied to what were (heretofore) concrete tangible assets (Finance Forum 2009).

Intangible asset, one could argue, is a non sequitur, in that the conclusion does not logically follow the premises. Limitations are inherent in the word *intangible* based on its semantic usage: as an adjective (or noun) that means abstract, ethereal, insubstantial, fleeting, elusive and unable to be grasped mentally (Oxford 1996). Instead of the phrases "tangible assets" and "intangible assets," this researcher proposes the transition to the more descriptive (and therefore, it is hoped, more accurate) idiomatic expressions of *corporeal assets* and *volitional assets*. If a firm is considered to be a complex living system, it is at least consistent with other business literature and research to use biological [and psychological] references (Pascale et al 2000). *Corporeal assets* therefore, are used to refer to the body of physical, financial and legally registrable assets that the firm controls in the conduct of its business. *Volitional assets* would include the organizational, competence and motivational assets that result from the collective and individual willpower found with the firm, demonstrated through choices made, options taken or preferences exercised by the firm and its management.

Seven asset categories were proposed in Chapter 4 (Chart IV). *Corporeal* assets would include four asset groups: Physical Natural, Physical Produced, Financial and Legal/Registrable. *Volitional* Assets would include the three asset groups of Organizational, Competence and Motivational. A more complete listing of proposed asset groups and sub-groups follows:
Group I. Physical Natural Assets (this asset grouping was inspired by the writings of Herman Daly in *Beyond Growth – The Economics of Sustainable Development* (1996):

- Non-renewables – including land, minerals, metals, fossil fuels and other non-renewable resources
- Renewables – including solar, wind, air, water, soil and biological renewable such as timber, crops, livestock, other plants, animals and biological resources

Group II. Physical Produced Assets (asset grouping divided into fixed and mobile categories based on accounting conventions of Europe) (Goode 2002):

- Fixed – including machinery, buildings, tools, investment property and electronic/hardware systems
- Mobile – including trucks/rolling stock, bulk containers, portable equipment, furniture and accessories, business and personal property, and original works of art and design

Group III. Financial Assets (adapted from GAAP 2008)

- Cash and cash equivalents – including currency, deposit accounts and negotiables
- Short-term investments
- Receivables
- Inventory
- Pre-paid expenses
- Long-term financial investments, such as stocks, bonds, special funds and some forms of insurance

Group IV. Legal or Registrable Assets (partially adapted from Reilly & Schweihs 2004)

- Intellectual property – including patents, trademarks, service marks, websites and domain names, copyrights and sealed designs
- Agreements, contracts and projects – such as franchises, licenses, projects, contracts and permits
- Other explicit and recorded assets – which may include internal trade secrets, databases and recorded or other explicit knowledge

Group V. Organizational Assets

- Organizational processes – including formal processes, informal routines, research and development and execution of business strategy

- Organizational structure – including legal structure, management structure, projects and contracts approach, and going concern value
- Technological – such as adoption of IT hardware, adoption of software, other new technologies and use of the web and virtual networks
- External and relational – including brand and reputation, customer base, outreach measures, repeat customers and goodwill

Group VI. Competence Assets

- Human assets – including education, experience and tacit know-how, professional skills and proficiencies, use of technologies, special talents and retention/promotion of workers
- Continuing development – such as training, team experience, interaction with customers, and knowledge acquisition and dissemination
- Embedded know-how and procedures – including sum of individual know-how, collective know-how, group routines and procedures, and deep interactions and mentorship of employees
- Culture and commitment – including attitudes, values and trust
- Esprit de corps and loyalty
- Sustainable practices
- Adaptiveness

Group VII. Motivation Assets

- Leadership – which includes leadership style, leadership effectiveness, entrepreneurial drive, integrity, and strategic communication and execution
- Innovation and creativity – including degree of innovative culture, rewards for creativity, challenging projects and designs, and aesthetic or functional awards

- Purpose, vision and strategy – including firm value proposition, articulated vision, strategic plan and planning, strategic plan diffusion and acceptance, forward reach of plan, and fit of product or service to the market

Many concepts and measurement models have been proposed over the years, including balanced scorecard (Kaplan and Norton 1992) and intangible assets monitor (Sveiby 1997). On the surface, a firm's classification of intangibles appears simple and easily communicated, but once the surface is penetrated a noticeable complex pattern emerges (Johanson et al 2000). The Society of Management Accountants of Canada defines a firm's intellectual resources as "Assets, in balance sheet terms, which are knowledge-based items that the company controls and that will produce a future stream of benefits for the company, and can include technology, management, consulting practices and registered intellectual property" (SMAC 1998). The SMAC organization developed a series of measures containing ratios and comparisons that would assist top managers in making organizational and human resource decisions for their firms. Among the categories and measures put forward by SMAC are:

Human Capital Indicators –

- Reputation of company employees with headhunters
- Years of experience in profession
- Rookie ratio (number of employees with less than two years experience
- Employee satisfaction percentage
- Proportion of employees making suggestions and suggestions implemented
- Value added per employee
- Value added per salary dollar

Organizational Capital Indicators –

- Number of patents
- Income per R & D expense
- Project lifecycle cost per dollar of sales
- Number of individual computer links to the database
- Number of times database has been consulted
- Contributions to the database
- Upgrades to the database
- Ratio of new ideas generated to new ideas implemented
- Number of new production introductions
- New product introductions per employee
- Number of multi-functional project teams
- Proportion of income from new product introductions
- Five year trend of product life cycle
- Average length of time for product design and development
- Value of new ideas (money saved or money earned)

Customer and Relations Capital Indicators

- Growth in business volume
- Proportion of sales to repeat customers
- Brand loyalty
- Customer satisfaction
- Customer complaints
- Products returned as a proportion of sales
- Number of supplier and customer alliances (respectively)
- Proportion of customers business is firm's business

In their 2005 essay about measuring business intangibles, economists Corrado, Hulten and Sichel recommend additional categories to be added to traditional physical and financial assets, including inventive and creative activities, knowledge embedded in firm-specific human and structural resources, and computerized information in the form of databases and software programs (Corrado et al 2005). The problem that these authors also recognized was the difficulty to developing firm-level measurements for these additions to traditional asset inventories. Which measurements would firms be interested in? Would the interest be sufficient so that a reasonable sample of non-traditional asset inventories was collected? Could there be a case made for firms to do the collection of metrics out of their own self-interest or would government have to encourage or require such collections?

A list of current and proposed asset measures are discussed in the next section of this chapter. The list has been pared down from what was a vastly expanded list at the outset of this research. It became apparent that a workable model must be constructed from fewer options, not only because of the time and resource constraints that would have been confronted by using an exhaustive list of asset metrics; but because only limited data points were available from firms not wishing to disclose copious amounts of information about their firms, whether the disclosure was due to more in-depth questions about finance or about organizational competencies. Therefore, the measures shown here were derived from survey questions that firms were willing (or at least were not opposed) to answer, as long as they were provided with an updated industry benchmarking report from the survey sponsor.

A selected shortlist of measures from the current and proposed lists shown in the following sections of this chapter (Sections 5.3 and 5.4) are then tabulated, compared and analyzed in Chapters 7 and 8. Commentary on each of the asset-based metrics, including advantages and disadvantages of using specific measures for research, accompanies both existing and proposed new measures.

5.3 Examples of Current/Existing Asset-Based Measures for Firms

5.3.1 Firm Growth and Profitability – Researchers of industrial organization and corporate strategy have been looking into these

issues as reasons for the existence and persistence of firm profits (Ramirez and Hachiya 2008). Factors affecting firm performance in the short run, however, could differ from those that insure its persistence (Jacobsen 1988). Ramirez and Hachiya found that neither profits nor sustainability were regular outcomes through empirical evidence about strategic resources. The authors of the journal article conjectured that firm success may be attributable to unobserved factors, such as a synergistic effect between their accumulated industry-specific knowledge and ongoing organizational capital (Ramirez and Hachiya 2008). A UK study of smaller firms examined whether firm age and experience affected profitability or growth over time. The study found that older firms may benefit from both experience and reputation effects, allowing them to earn a higher margin on sales; but that older firms may have developed routines that are out of touch with market conditions, in which case an inverse relationship between age and profitability could be observed (Glancey 1998). Another perspective on maximizing profits is Warren Buffet's careful investment response to stock volatility over the last ten years. The Oracle of Omaha instructs investors to look for companies with sustainable competitive advantage, not high profits. Buffet's litmus test is to find firms that have small, but steady growing stock dividends over a ten year period, which would indicate solid management, sustainable growth and reasonable, consistent income (Bianco 1999). The conservative investor or firm manager can make choices that offer alternative paths: excessive profits or slow growth, maximum short-term revenue or modest-but-sustainable income, with an eye toward either current year income or long-term survival. In the recession of 2007 – 2010, the firm growth and profitability measures are perhaps less useful than a firm value and continuity measures.

5.3.2 Value of the Firm, Including Market, Book, Going Concern and Liquidation Values – Much of the research interest in non-traditional assets has focused on explaining why a firm's market value was sometimes much higher than its book value, occasionally market values ranging as high as three or four times book value (Lev 2001). The definition of book value is the value of an asset accounted for on a balance sheet, minus total depreciation, depletion or amortization. For the firm overall, book value is often viewed as total assets minus total liabilities (Reilly & Schweihs 2004). Market value is the estimated amount for which the asset or property should exchange on the date of valuation between a willing buyer and willing seller in an arms length transaction wherein the parties each acted knowledgably, prudently and without compulsion (IVS 2006). Going concern value is the market value of all the tangible and intangible assets of an established operating business (as if sold intact and as an aggregate) with an indefinite life (Dimbath 1994). Liquidation value is considered synonymous with salvage value, or asset value at its most elemental form, such as machinery sold for scrap metal (Reilly 2006). Mergers and acquisitions advisors occasionally list all four forms of value to provide a perspective-based view of firm worth to a buyer or seller. Such valuations allow the comparison of assembled assets in an operating firm to the value of individual assets simply summed up based on individual asset values. Going concern value measures the enhancement in value of inputs of the firm as a result of being combined into production, with the implication being that assets are more productive when combined with other assets than in isolation (Dimbath 1994). If assets combined are not worth more than the value of their individual parts, either the assets are being severely underemployed or there is no economic justification for the firm in the first place.

5.3.3 Employee Retention/Turnover – One of the traditional gauges of firm stability has been staff turnover. A classic turnover ratio is considered to be the number of employees who left during a year out of the total number of employees (William and Katz 1999). Turnover is an annual spot-check on the workforce as a whole, while retention follows specific people or groups of people indefinitely over time (Waldman and Arora 2004). Average annual turnover rate for all firms is 12 percent, but there is no parallel statistic for retention (William and Katz 1999). Some researchers argue that some employee turnover is not necessarily bad for an organization (Meier and Hicklin 2007). Retention is calculated by taking the number of retained employees times 100 divided by the number of positions in the organization (William and Katz 1999). As task difficulty within the organization increases, retention of talented employees becomes more important because these are the workers that are the most difficult to replace (Meier and Hicklin 2007). Even during economic downturns, employees have choices about where, for whom and how long they work --- turnover statistics cannot show the whole picture, so should be used in conjunction with retention rates, especially due to the type of firm (e.g., value chain vs value shop) being investigated and the skill/knowledge profile of its workforce.

5.3.4 Staff Development Programs – Many firms follow undifferentiated strategies toward staff development in that they let employees manage their own careers. In these firms, managers are not held accountable, supported or rewarded for the development of their workforce (Huselid et al 2005). One researcher looked into whether firms should begin to measure employee lifetime value by looking at financial value generated when training, technology and support for individual employees and employee groups was maximized (Hill 2008). Another found that external professional training in large and small firms was positively related to the firms' financial performance (Chen et al 2008). Studies are inconclusive, however, on the number of hours/days of staff development per year are necessary to provide greater firm profitability, worth or longevity. According to Westhead and Storey, training can be a powerful agent of change, facilitating and enabling a company to grow, expand and develop; however, the relationship between training and firm performance is not well established through findings in the research (Westhead and Storey 1996). A final study about knowledge acquisition in knowledge-intensive firms concluded that, once professionals (assumed to have degrees and licenses in their fields) were hired within a firm, a greater part of their work had to do more with experience and skills in adapting to new situations rather than narrow expertise, suggesting that training and coaching in verbal skills, empathy, persuasiveness, creativity and other orientations were as valuable as base scientific or engineering knowledge (Alvesson 1993).

5.3.5 Technology Adoption – A comprehensive study by Papageorgiou and Perez-Sebastian found complementarity between technology adoption and human capital match-up within Japanese and Korean firms, which resulted in fairly rapid growth rates of value-chain-type firms (Papageorgiou and Perez-Sebastian 2002). The researchers concluded that both technological progress and human capital were necessary engines for growth, provided there was labor reallocation to accommodate the new technology. Another research project examined the relationship between technology innovation and firm performance in Europe. The conclusions of the European study suggested that all types of technological innovation, including internet-enabled and non-internet enabled product or process innovations are positively associated with revenue and employment growth of firms, but not necessarily associated with higher firm profitability (Roellinger 2008). In his seminal paper on technology and growth of international business, Teece established that technology is not a public good (easily replicated by other firms) but rather a private good (difficult to replicate), which would cost between 2 percent and 59 percent of existing total costs to transfer to a subsidiary or partner organization (Teece 1977). Finally, in a study of technology adoption given to project engineers in Sweden, researchers found that technology transfer lies at the heart of the issue of growth of firms, especially where the age of the technology is post-early-innovation but resulting in para-monopolistic market advantage (therefore, not aging technology that is being exploited by multiple firms) (Kogut and Zander 2003).

5.4 Proposed Additions to Asset-Based Measures for Firms

5.4.1 Portfolio of Projects/Contracts Held by the Firm – In terms of supra-assets held by A/E/C firms, a portfolio of projects are an aggrandizement with a value that increases or decreases over time. A project can be defined as a complex effort, usually less than three years in duration, made up of interrelated tasks, performed by various organizations, with a well defined objective schedule and budget (Archer and Ghasemzadeh 1999). A project portfolio is a group of projects, carried out by management and sponsorship by a firm, that competes for resources (people, products, finances, and other assets) available from the firm and its customer (Archer and Ghasemzadeh 1999). Among the project/contract based measures that have been employed in other research are blended economic return on projects such as Net Present Value, the Capital Asset Pricing Model (Khan and Fiorino 1992), portfolio risk assessments, project volume plus staggered inception/completion schedules, and other project metrics based on economic, strategic and other foci (Martino 1995). Some research has tried to uncover the similarities and differences in tangible and intangible project resources to develop proposed organizational learning models, suggesting that this model demonstrates the synergies that lead to firm and project innovation (Cavaleri and Fearon 2000). Daniels and DeJonge have proposed a blended model for scoring projects and portfolios according to strategic financial and intellectual capital scorecard factors; which would show trade-offs between profit maximizing projects versus those projects that would develop core competencies and build customer satisfaction, but have little or no profit (Daniels and DeJonge 2003). However, the assembly and use of such a software tool is beyond the scope of this research project.

5.4.2 Strategic Planning and Alignment – The question of whether strategic planning fulfills key firm objectives has occupied researchers for more than a generation. Strategic planning, which is generally defined as firms looking at the future in a systematic way to understand future implications of present decisions, has its proponents and its critics (Loasby 1967). Ansoff warned that strategic decisions were made within the practical framework of limited total resources, and that organizational objectives ought to be tied to asset allocation patterns that rationalize make or buy decisions (Ansoff 1969). Mintzberg cautioned that formalized planning was only helpful in a relatively stable economic environment (Mintzberg 1979). One research study looked into two measures of the effectiveness of strategic planning, including how planning capabilities were improved over time and whether specific planning objectives were fulfilled (Venkatraman and Ramanujam 1987). The problem with earlier measures used in research was the limited examination of formality of strategic planning and company financial performance, which has been assailed as being overly simplistic. If valid measurement is the *sine qua non* of science, and measures used in a discipline have not been shown to have a reasonable degree of validity, then the discipline itself (i.e., strategic planning and management) is not a science (Venkatraman and Ramanumjam 1987). However, indicators from a 1993 study based on Business Week Top 1,000 companies showed that firms with the most sound planning systems had a three-year higher average return-on-investment than firms with weaker planning systems (Desai 2000). A study that relied on ratings of experts to assess results of formal planning cautiously concluded that formal planning had benefits for firms, and that the small difference in performance resulting from strategic plan implementation may affect the firm's survival potential (Schwenk and Shrader 1993). Neverthless, Kaplan and Norton warn that if a firm is performing inadequately in the area of alignment and in developing the right culture to implement the strategic plan, these problems will lower the firm's overall readiness to use strategic assets (Kaplan and Norton 2004).

5.4.3 Stimulation of Innovation, Entrepreneurship and Creativity – As mentioned in Chapter 2 of this research project, creativity in an economic context is the production of new ideas to fit a particular productive purpose (Tether 2005). The method most commonly used to collect data for innovation-related indicators has been the sample survey (Perrolle and Moris 2006). At the micro-level, more detailed case studies and qualitative measures may give more interesting and informative results about how things work, but case study findings cannot be generalized beyond the limits of the case. Innovations come from many different sources and exist in many different forms, and there is a dichotomy between radical and incremental innovation (Egbu 2004). Similarly, there is a dichotomy between innovative entrepreneurship and replicative entrepreneurship (Wadwha 2010). Within a firm, a climate favorable to innovation may be achieved by committing resources, allowing autonomy, tolerating failure and providing incentives for creativity (Tatum 1987). Measures of innovation and creativity include new technology and/or processes that are beneficial to the company internally or externally, as well as development of products and services for customers that provide ongoing competitive advantage for the company (Egbu 2004).

5.4.4 Environmentally Sustainable Practices – One researcher has suggested that businesses have four corporate responsibility options to consider that can be adopted as a whole or in part, including shareholder – economic focus for owners of the firm, altruistic – target donations to selected organizations and causes, reciprocal – ongoing social responsibility is regarded as good business, and citizenship – firm identifies and works with stakeholders toward greater societal good, such as in environmental restoration projects (Galbreath 2006). Customers are beginning to demand that their suppliers use sustainable practices and materials for reasons of environmental stewardship, and they seek disclosure of these company practices in annual reports and advertising (Rusinko et al 2003). A number of researchers have been looking into the voluntary use of indicators by specific industrial sectors. One particularly thorough study examined indicators used by the pharmaceutical industry, and developed a tool to organize indicators by level: Level 1 – facility compliance and conformance, including conformance with regulations, notices of violations and dollar level of fines paid; Level 2 – facility material use and performance, including inputs and outputs, byproduct management and emissions quantities; Level 3 – facility effects, encompassing potential effects of a facility on the environment or on worker health and safety, such as CFC emissions per year, or dust and particulate levels for factory workers; Level 4 – supply chain and product life-cycle, which goes beyond the boundary of company processes and looks at the entire organizational supply chain, and looks into post consumer recycled material use and CO2 emissions from delivery and transportation; Level 5 – sustainable systems, which uses indicators that show how a company's production processes fit within a larger economic, social and environmental system, such as percent of water from local sources versus recharge rate, and total energy use from non-renewable and renewable resources (Veleva and Hart 2003).

5.4.5 Adaptive Culture Indicators – In a closed equilibrium system, a company would look at its position in the current economic structure, consider the changes that could occur, and then develop point of view or new Marshall-type equilibrium that would last for a period of time (Beinhocker 1997). Marshall's widely-accepted equilibrium model was a reasonable approximation to the agricultural and manufacturing economy of an earlier century, but it doesn't necessarily hold up in a dynamic or volatile economy. A number of newer successful firms and industries (cellular phones, personal computers, big box retailers) violated the equilibrium model by innovating in business systems or by developing mental models of how their firm should approach the market despite the approaches of the incumbent competitors (Beinhocker 1997). One set of researchers attributed the adoption and diffusion of processes and technologies to capacity for internal learning, industry growth rates, costs of new technologies and expected changes in the firm based on new technologies (Karshenas and Stoneman 1993). In an examination of organizational and adaptive culture studies, Lim found conclusions of only modest correlations between indices of a strong culture and long-term performance and no conclusive correlation between adaptive culture and short-term performance (Lim 1995). Finally, one qualitative study claimed that firms with consistently good economic performance over time were shown to possess core values that emphasized the importance of an adaptive culture, which included "distinctive ways of doing things" within the firm and a motivated workforce committed to a common set of core values (Kotter and Haskett 1992).

5.4.6 Continuity/Expectations of Longevity – The question of why some firms survive and others die out is one of the basic concerns of business scholars (Suarez and Utterback 1995). Teece suggested that firms with longstanding trajectories enjoyed such advantages as collateral assets (one or more key assets work in combination with other key assets, all of which are under control of the firm), network externalities, supportive industry regulation and positive effects of firms' strategic maneuvering (Teece 1986). Additional measures for determination of firm success over time include enforcement of standardization to realize production economies, entry timing of evolutionary technology (some tire firms kept producing bias ply tires after radials were well established), and market relevance of product or service (especially in dynamic markets with changing tastes and demands) (Suarez and Utterback 1995). Dimbath cautions that, when looking at surviving firms for valuation, one must measure goodwill and going concern value separately, since goodwill may be absent in a highly competitive market or where wrongdoing or perception of wrongdoing has devalued goodwill, but the processes embodied in a going concern (that create useful products and services for sale) are nevertheless primary assets (Dimbath 1994). Thornhill and Amit suggest that younger firms expire if their initial asset endowments are exhausted before they are able to develop value-creating strategic assets, and older firms may become unfit due to how they are suited to the current economic environment and to the way that their strategic posture fits with changes in the economic environment, relegating certain firms to obsolescence (Thornhill and Amit 2003). Recently, some researchers have concentrated on specific problems of firms in distress with frameworks that are purported to conduct “stress tests” on firms using indicators of reductions in cash flow, debt restructuring and other accounting yellow flags (Turetsky and McEwen 2001).

5.4.7 Willingness to Take on New Technical Problems/Challenging Projects – Firms in a number of industries rely on knowledge and processes generated outside of the firm for strategic growth, which has been interpreted as evidence of “absorptive capacity” (Markiewicz 2004). There have been a number of research studies that have shown performance benefits stemming from the firm’s ability to access and incorporate knowledge external to the firm, particularly when a set of capabilities serves as a platform from projecting the firm into related product areas or new markets (Zander and Kogut 1995). Among the indicators of exogenous knowledge brought into a firm are license agreements, contracts for projects, and replication (through overt or covert information gathering) of external product or service innovations. An integrated framework for project selection has been proposed by researchers wherein projects are scored according to work force availability, return on investment, risk, market research and strategic reasons such as competitive advantage (Archer and Ghasemzadeh 1999). One research project also looked at an activity that had not been discussed in previous research – matching projects to firm competencies and key people – and found that strategic opportunities could result co-development of project portfolios and project managers (Bredin 2008). However, the ability of a firm to access and assimilate knowledge may be specific to a particular source of external knowledge, due to existing networks, market orientation and social ties (Markiewicz 2004). This concern is borne out in a study about implementation of environmental best practices by firms, which demonstrated that firms lacking in capabilities for process innovation were better off waiting for early adopters – competitors – to try the environmental management measures first, and then imitating the successful ones (Christmann 2000).

5.4.8 Emphases on Deployment of Asset Categories by Representative Types of A/E/C Firms – While many research studies have concentrated on measuring the effects of an individual asset or asset category, only a few have tried to look at multiple asset categories, and just a handful have tried to combine both tangible and intangible assets. One such study uses five categories of tangible and intangible assets, but fails to include categories for intellectual property and external natural capital (that latter of which is often used without cost on the input side and can be degraded as a result of production processes and use over the life of the product) (Roos et al 2005). Therefore, this research project relies upon new asset categories that are better aligned with experimental asset classes proposed by the Bureau of Economic Analysis in 2005, and discussed at length during a National Academy of Sciences conference in 2009 (Corrado et al 2005, Mackie 2009). A fundamental question is posed in the debate between proponents of tangible asset measurement (traditional) versus those who support intangible asset measurement (experimental): Is the real measure input cost of assets, or invested time? (Mackie 2009). The answer cannot just be one of the two, but is rather both but at varying levels of emphasis depending on type of firm, strategy and other attributes. One earlier study that seems to have grappled with the blend of asset categories that can be deployed by firms organized capital according to a.) operating capabilities, such as design systems, production management, outsourcing and marketing, b.) investment capabilities, including advanced project selection, personnel training, risk management and financial engineering, and c.) innovation capabilities, such as research, development, adaptive capacity of learning from others, communities of practice and intellectual property protection and exploitation (Evenson and Westphal 1995). Nordhaus and others make the case for a fuller accounting of inputs based on a mix of market and non-market factors, which would properly begin to account for changes in environmental externalities both at the input and output side, allowing for a measure of welfare expanded and not simply wealth concentrated (Jorgenson et al 2006). Measuring intangible asset categories remains a substantial barrier; however, and requires a framework from which to account for time use and other intangible factors that is generally accepted by businesses.

5.5 Selected Key Measures for this Research

This research is predicated on the use of mixed methods for investigation of the problem. A top-down, bottom-up two-phased sequential approach requires examination of data from a third-party survey that looked into a limited set of individual assets incorporated as factor inputs by A/E/C firms, followed by survey of industry experts to ascertain whether factor input emphases of general asset categories differ depending on business strategy (products/services offered) and value logic of classes of firms in the pool.

5.5.1 Selected research variables for the quantitative portion of the study are listed below, with descriptive data extracted from the third party survey (ACEC Industry Trends Survey) used for Phase I of this research:

- Business and Strategic Planning
- Training and Education – Continuing personnel development programs through training and education and net effect upon firm profitability
- Profit Margins
- Propensity to Adapt and Innovate
- Willingness to Undertake Technical Problems/Challenging Projects
- Sustainable Environmental Practices
- Acceptance and Use of New Technologies
- Firm Longevity
- Per Capita Revenue
- Firm Quick Ratio (Liquidity)
- Knowledge Assets Deployment

5.5.2 Selected Measures in Phase II (Chapter 8) of the research methodology include portions of the following:

- Asset Group Emphasis (seven categories of tangible and intangible assets)
- Selection of Assets for Firm Continuity and Longevity, versus Selection of Assets for Firm Short-Term Profit Maximization
- Selection of Assets According to Professional Affiliation (Engineer, Architect, Constructor, Design-Builder or EPC, Facility Owner)
- Value Logic (Production Scheme) of Firms – Value Chain, Value Shop or Value Network
- Individual Asset Emphases (Rather than Asset Group) for Types of Firms as Selected by a Panel of Experts (Delphi Group)

5.6 Proposed Conceptual Model of Flow of Assets – Traditional Asset Categories Coupled with Organizational Assets, Competence Assets and Motivation Assets

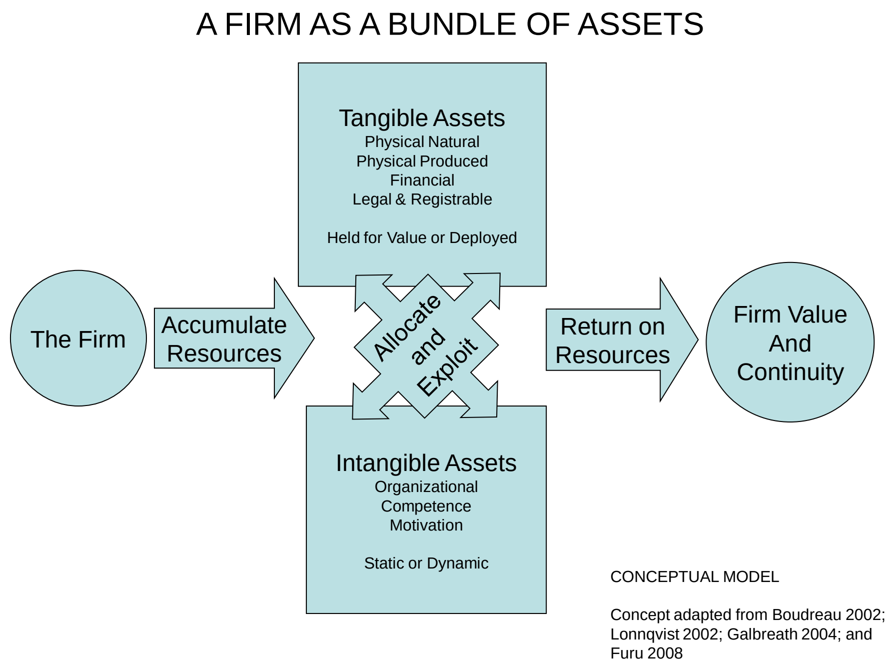


Figure 5 A Firm as a Bundle of Assets

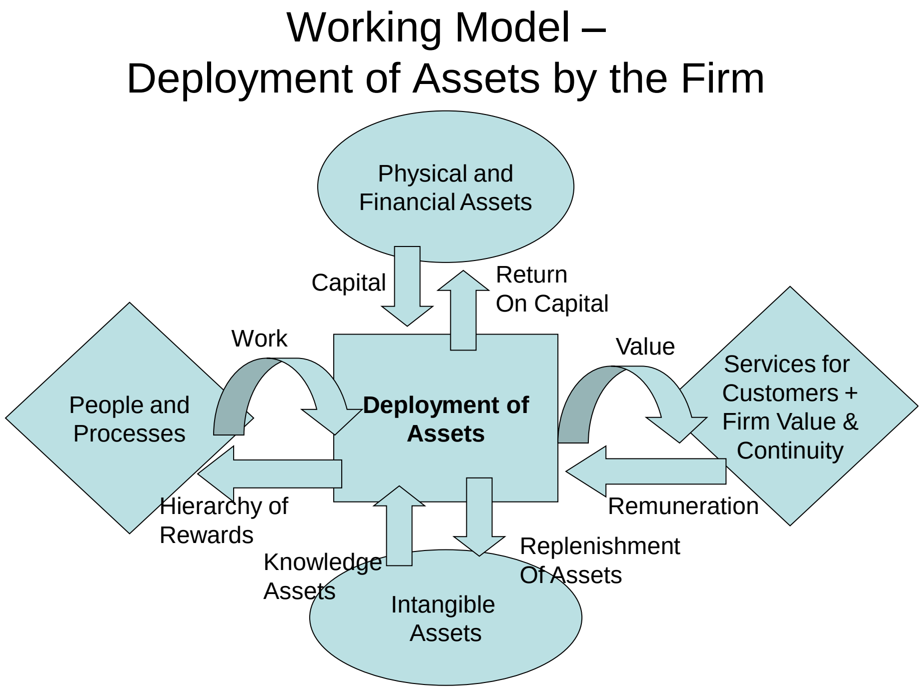


Figure 6 Working Model of Deployment of Assets by the Firm

"*The new source of wealth is not material, it is information, where knowledge is applied to work to create value.*" __ Walter Wriston, former Citicorp Chairman, writing in *The Twilight of Sovereignty*, 1992

"*A picture is worth a thousand words, but a metaphor is worth a thousand brush strokes*." __ Alan Kaye, Apple Computer, 1993

CHAPTER 6 METHODOLOGY, DATA COLLECTION AND MODELING

6.1 Methodology Using Quantitative and Qualitative Approaches – Mixed Methods

The scientific method is a set of ideas, rules, techniques and approaches that help structure a way of investigating some question about the world (Neuman 2003). A loose consensus has arisen among scientific researchers who share the following norms (adapted from Neuman 2003):

- Universalism – Regardless of who has conducted the research (whether newly minted PhD or emeritus) and at what institution (whether Emory or Appalachian State), the research is to be discussed only on the basis of its scientific merit.
- Skepticism – Researchers should challenge and question all evidence and subject each study to intense scrutiny; not to attack the individual doing the study, but to ensure that the methods used stand up to close examination.
- Disinterestedness – Scientific researchers must be impartial and neutral, and open to unexpected observations and new ideas. By looking for evidence that runs against their positions or assertions, they may discover new findings based on high-quality research that can be accepted and built upon.
- Community of Scholars – Knowledge must be shared because the creation of knowledge is a public act, and the findings public property. The way in which the research was conducted should be described in detail and available for others to replicate. New knowledge is not formally accepted until it has been reviewed by other researchers, as in a peer journal.

- Honest, Ethical Behavior – The research community demands forthrightness and honesty in scientific research; and dishonesty, cheating or manufactured results are deplored and culturally, if not legally, punished.

The philosophical assumptions underlying this research are based on a positivistic, deductive framework for inquiry, followed by a qualitative, inductive phase used to pose open-ended questions and to further explore the findings and results. Research projects start with assumptions about what will be learned (ontology) and how it will be learned (epistemology) (Crotty 1998). Positivism is the most common philosophical outlook on science, but there are alternatives such as interpretive and critical approaches, that have significant merit (Miller 1987). Positivism sees science as an organized method for combining deductive logic with precise empirical observations in order to discover or confirm a set of probabilistic causal laws that can be used to predict outcomes (Neuman 2003). Because certain laws and theories govern the world, these need to be tested and verified, or further refined, so that the world can be more completely understood (Cresswell 2003). Positivists maintain that knowledge is conjectural, and since absolute truth cannot be found, research serves as a process to make claims that can be refined or rejected in favor of other claims whose basis is more strongly warranted (Phillips and Barbules 2000).

A research design combines elements of philosophical ideas, strategies and methods into an overall approach (Cresswell 2003). The first step is to determine what school of epistemology; that is, what theory of knowledge is underpinning the philosophical stance of the research (Crotty 1998). Objectivist assumptions are positions formed based on what people see and touch, which is an empirical reality based on observations about nature and the natural order of the world. Subjectivist assumptions (also called constructionist stances) are founded on the belief that much of what is known is symbolic and based on interactions with the environment (Neuman 2003). These two orientations toward reality modify the distances between fact and theory. A strict empiricist would argue that theory must be constantly tested against cold, hard facts found in the empirical world; whereas a full-blooded subjectivist or constructionist would say that any “fact” is contaminated by ideas and beliefs clouded by values and limited experiences (Neuman 2003).

A second step in research inquiry, according to Crotty, is to determine what theoretical perspective undergirds the methodology (Crotty 1998). As stated earlier, the dominant part of this research assumes a positivistic stance, where data, evidence and rational considerations guide the process. The initial theoretical understandings may not remain fully intact, as efforts will be made to dissect those theories logically, clearly and deeply during the research process. A third step in designing a research program is setting forth a plan of action that links methods to outcomes, which is also known as a methodological strategy (Cresswell 2003). For this research, a national survey of multiple firms within an industry sector is employed, followed by a focus group and individual interviews to verify validity and findings. This strategy of inquiry leads the researcher to techniques and procedures involving the development of a questionnaire, conduct of a survey, and subsequent collection, organization and analysis of survey data

Once the elements of research inquiry have been settled, one of a number of accepted approaches to research can be chosen. Quantitative research strategies rely upon attitudinal, observational and performance data, followed by statistical analysis. Qualitative research methods include observation data, document data, open-ended questions and interview data (Cresswell 2003). Therefore, for this research project, a mixed methods approach wherein the researcher can base knowledge claims on pragmatic grounds, using quantitative and qualitative data sequentially, seems appropriately suited to the research problem at hand.

The choice of mixed methods research is appropriate to studies in which the research problem poses a need to both explore and explain (Tashakkori and Teddlie 1998). Researchers choose mixed methods design as a way to confirm findings from different data sources or to converge related theories and empirical findings in order to provide novel explanations (Cresswell 2003). Implementation of the mixed methods approach will be sequential, with quantitative data gathered and analyzed first, followed by qualitative data gathering and analysis necessary to expand the understanding of the outcomes. Since the purpose of sequential explanatory strategy research is to use qualitative results to further explain or interpret the findings of the initial quantitative phase, it can be especially useful in drawing out what may be unexpected results from the quantitative analysis (Morse 1991).

6.2 Research Problem and Statement of Intent

A serious researcher would not want to devote time and resources to a study that mirrors exactly what another researcher has already done; but rather seeks to add to the literature or extend what others have already examined (Cresswell 2003). Previous studies have explored the issue of whether intangible resources are associated with the performance and market advantages of firms. What this research project attempts to examine whether a combination of specific tangible and intangible assets are associated with firm value, strategy and continuity.

The resource-based view of the firm, while certainly alluded to by Edith Penrose in 1959, came of age with Wernerfelt's award-winning journal article that described a firm in terms of its resource endowments (Wernerfelt 1984). The main prescription of the resource-based theory is that a firm possessing resources meeting two or more of Barney's "tests" (i.e., valuable, rare, inimitable and non-substitutable) may have competitive advantage and staying power in the marketplace (Barney 1991). Wernerfelt noted that both tangible and intangible assets are tied to the firm, and these may include machine capacity, customer loyalty, production experience and chronological leads in technology (Wernerfelt 1984).

In an attempt to verify resource-based theory's main prescription, a mixed-methods approach is important for three main reasons. First, in order to measure the effect of a particular resource or bundle of resources on firm value, competitiveness and continuity, selected variables will be measured quantitatively. The quantitative measurement of independent variables (e.g., specific resources) on firm value and continuity can provide factual data for verifying resource-based theory, which is the purpose of empirical research

(Popper 1959). Second, most of the research surrounding resource-based theory of the firm is limited to only intangible resources (ignoring traditional fixed and financial assets) or suffers from looking at a single resource at a time, rather than two (or more) resources in a resource bundle. If resource bundles are a vital construct in the understanding of the dynamics of a firm (Marr et al 2003; Coad 2008), it is untenable that previous research has not attempted to uncover more empirical data to further understand and refine resource-based theory. Third, if firms are differentiated in the marketplace into heterogeneous competitors based on their resource endowments, it may be more useful (especially after the recession of 2007 – 2009) to compare firms' long-term value and continuity rather than short-term profit and growth as is done by nearly all of the contemporary research (Becsi 2002).

Superior performance of firms can be partially explained by accrual of rents to specialized and high quality assets (Peteraf 1993). Costly or imperfect information can impede the movement of resources and if a firm builds capabilities internally (a form of intangible assets), its competitive advantage is much less likely to be dissipated (Dierckx and Cool 1989). Finally, recent research studies have suggested that no individual resource creates a firm's positional advantage, but rather resources in combination or collectively are responsible for economic sustainability (Hult and Ketchen 2001; Galbreath 2004). Follow-on research can heed Foss's admonition of necessarily investigating which combinations of tangible and intangible resources are more likely to support ongoing firm value, strategy and continuity, which would entail knowing what resources are more important, how they are used and why they appear to help the business over time (Foss 1996).

The intent of this two-phase sequential mixed-methods research study is to obtain statistical, quantitative results from a sample and then follow-up with a small sample of key industry participants to probe and explore those results in more depth. In the first phase, quantitative research questions are posed to address the relationship of intangible and knowledge assets to the value and continuity of firms in the facilities/infrastructure design and construction sector. In the second phase, interviews are conducted and observations sought from COOs and CFOs employed by firms from the sample population in order to probe significant results of the quantitative study. By exploring aspects of the central phenomenon – bundles of assets that make up a firm – with two dozen seasoned industry participants, additional insights into managerial applications of the total firm resource pool may be revealed. Therefore, the overriding purpose of the study is to clarify the presumed link between dynamic asset bundles at the disposal of a firm and the firm's value, strategy and continuity. A secondary purpose is to elaborate on quantitative findings by asking a few open-ended questions about firm "staying power" and sustainable strategies in order to provide a qualitative perspective to the research.

6.3 Data Sources and Sampling Strategies

The use of secondary data sources to study organizational assets as predictors of firm success is a significant issue for researchers looking at intangible resources of firms. Unlike tangible (physical and financial) resources, there are no generally accepted accounting standards that guide firms in reporting the value or relative strength of their intangible assets (Galbreath 2003). However, the use of representative data sources and credible sampling techniques allows the conscientious researcher to compile a smaller collection from the population to produce relatively accurate generalizations about a larger industry group. For this research, the population pool is comprised of engineering firms working in the built and natural environment within the United States. According to the Department of Commerce, there are approximately 80,000 of these firms in the country, ranging in size from sole proprietorships to firms with 10,000 or more employees. A representative cross-section of this population are the 5,800 firms belonging to the non-profit American Council of Engineering Companies (ACEC). These multi-disciplinary firms provide engineering management services, planning, design, construction and facilities operations services across all market sectors, including buildings, civil infrastructure and industrial projects.

A mismatch between a sampling frame (representative cross-section) and a conceptually defined population (design and construction industry) could be a source of statistical error. The fundamental question of sample reliability is whether the target sample fairly represents the population. The size of the sample is less important than whether or not it accurately represents the population (Neuman 2003). Because other data being used for analysis is homogenized federal government financial and statistical data, and since the US government does not recognize the design and construction industry as a related industry (i.e., there is a strict segregation between professional services and extraction, manufacturing and construction), the use of a sampling frame that integrates multiple disciplines (architecture, multiple engineering disciplines and construction) is a substantial improvement on United States government data. Nevertheless, it is recognized that construction may be underrepresented in the sample, but not to the ultimate detriment of the population integrity (for example, contamination of the sample could occur if firms from outside of the design and construction industry responded to the questionnaire and these firms were not eliminated. One such firm from the insurance industry was expunged from the data pool).

In mathematics, the central limit theorem suggests that as the number of successive random samples increases toward infinity, the pattern of samples becomes more predictable. With a large number of random samples, the sampling distribution forms a normal bell shaped curve and the mid-point is close to the total population parameter as the number of samples increases. But most researchers don't have the time or resources to generate multiple samples from a population. Fortunately, the central limit theorem lets the researcher calculate the probability of a particular sample while recognizing the margin of error by employing confidence intervals (Neuman 2003). Generally, probability sampling is preferred by quantitative researchers because it produces a sample that can be used to reflect the target population and it enables the researcher to use statistical analysis to illuminate various aspects about that population.

Sample size is another issue related to the characteristics of the total population pool. A principle of sample sizes is that the smaller the population, the larger the sampling ratio has to be for accuracy; whereas for a large population permits smaller sampling ratios. For small populations (under 1,000) a sample size of 300 is required for a high degree of accuracy; for mid-sized populations (10,000) a sample size of ten percent can be very accurate; and for large sample sizes 100,000 plus, a sample size of one percent is considered sufficient for accurate measurement (Neuman 2001). Because the population identified for this research is comparatively homogenous, a smaller sample size is acceptable and should be reasonably accurate according to accepted statistical standards.

Researchers use samples to draw inferences from the sample to the population as a whole. But a gap exists between what a researcher actually has, which is a concrete sample, and what is of real interest in the research, which is the entire population (Keppel 1991). By using observable data as approximations of abstract constructs, it is possible to estimate what is of real interest in the research: measures of the constructs and how they behave under causal laws, qualified by the level of confidence one has in the sample being equal to the population parameter (Neuman 2003).

6.4 Survey Questionnaire

A common method of capturing data related to the behavior of industrial organizations is the field research questionnaire (Stone 1978). Generally, the survey design for this research project will be cross-sectional, in that the primary survey data was collected during 2009, but there are some longitudinal data sets available from previous surveys, and in a few instances where this data is available and germane to a specific construct, it may be used to expand the data set or to develop a time series (showing whether the result would change over time due to exogenous factors). Because some of the questions in the 2008 survey questionnaire are based on longitudinal scales (performance over the previous two or three year period); portions of the survey data could be termed quasi-longitudinal (Hall 1992). Nevertheless, it is acknowledged that employing a two or three year period may be insufficient to show continuity or sustainable firm performance, and that a longer period [5 to 10 years?] may be preferable (Peteraf 1993).

The form of data collection for this research is the self-administered questionnaire, which was completed either online (web-based) or in original mailed survey format (Nesbary 2000). As mentioned earlier, the population for the study is composed of engineering firms that focus on projects in the built and natural environment with business establishments within the United States. The Bureau of the Census counts just over 80,000 (population "universe") of these entities in the United States (Census Bureau 2007). A portion of these firms (a cross-section) belong to the American Council of Engineering Companies (ACEC) because of their business and professional interests. ACEC membership tends to be stronger in some states (more in the Midwest than in the Southwest, with all other regions tending to have similar penetration), however the range of sizes (in terms of number of employees) and market focus (buildings, civil infrastructure, industrial) of these firms is consistent with the total census bureau pool across the nation. The ACEC target population sample consists of 5,800 firms. Single stage sampling was conducted because access to companies and names was direct, rather than through secondary sources.

The survey instrument for Phase I of the research was an intact format (as opposed to a novel or modified instrument), used since 2004 by the American Council of Engineering Companies and modified slightly each year to incorporate new questions developed by its Board-level Management Practices Committee. Permission to use the survey was provided by ACEC's Staff Vice President and volunteer chairman of its Management Practices Committee. It is also this committee that pilot tests the survey prior to its distribution each year, which ensures that the questions are clear to potential respondents and whether the answers are based on common interpretations of the questions. A copy of the survey instrument is found in the Appendix of this document.

Experienced survey researchers suggest that questionnaires should be simple, easy to read and to the point, with questions of a no more than a medium-length of 16 to 24 words and the entire questionnaire of less than 12 pages (Frazer and Lawley 2000). The survey questionnaire consisted of a cover letter reassuring potential respondents of the confidentiality of the survey and providing simple instructions for completion and submission, plus information about the seven key content areas (organized into logical chapters about firm performance) with originator contact numbers/email addresses and submission deadline requirements. From an ordering perspective, if asset based questions were ordered according to asset category, order bias may have been introduced (Frazer and Lawley 2000). Consequently, asset based questions appear in random order in the questionnaires and are not rotated (Fahey 2002; Galbreath 2004).

Given the specific focus of the sample frame, only firms operating as A/E/C firms are included in the study. These firms, while specifically recognized as being permitted by federal, state and local governments to offer professional engineering services, frequently offer architectural and other professional services as well as construction management (both at agency-type/at-fee and general contractor/construction manager at risk). Excluded from the study are all other types of business establishments from extraction, manufacturing and service sectors. Based on the survey design, the firms can be stratified into full service multi-discipline, multi-discipline (but not full service) and single discipline specialty firms. In addition, firm data can be segregated according to firm size in number of employees, with gradations of less than 6, 6 – 20, 21 – 50, 51 – 200, 200 – 500, and 500 +. Data from firms in brackets employing 6 to 500 persons meets commonly accepted creditable response rates, but the data pool from very large firms and very small firms may be statistically inadequate for firms at these margins.

The survey also permits segregation of data across the total range of major domestic markets and by regional geography. The A/E/C markets are based on McGraw-Hill Dodge categories of transportation, water and wastewater, buildings – commercial and institutional, industrial and process, environmental – other than water and wastewater, residential and energy and power. Geographical distinctions include northeast, southeast, midwest, midsouth, northwest and southwest. Finally, the data is divisible according to public or private customer base. In the aggregate, work for public customers comprises 47.99 percent of the total versus 47.56 percent for private customers. The balance (2.51 percent) is attributed to non-governmental organizations or non-profit entities.

6.5 Collection and Assembly of the Quantitative Data

To encourage informants to participate in the research survey, a personalization of outreach (such as in a cover letter), assurance of confidentiality and offering of incentives are positively associated with building successful data sets (Delener 1995). Each of these recommended steps were implemented during the course of survey activities, with the incentive consisting of promising respondents a complete electronic version of the survey results free of charge (the publication retails for $199 for the electronic version; and $299 for the printed version). The survey was mailed in December 2008 (and in December of each previous year beginning in 2005) and responses were due by March 1, 2009 (early spring in each previous year). A follow-up letter was sent to all firms in the sample frame in mid-January, and reminders were sent via internet e-mail during the second week of February.

Total responses to the 2008 survey consisted of 103 survey questionnaire forms, and following review, 98 responses were accepted as complete, for a response rate of 1.7 percent. Investigation of response/non-response bias was done by follow-up phone calls to four non-respondents to determine (using firm profile questions and then selected verbal questions/answers). Since these responses were beyond deadline, incomplete and solely used for determining if there were response/non-response bias, none of this information was appropriate for the original survey data pool. On its face, the response rate seems somewhat low; however the size of the sample taken is less important than whether or not it represents the population (Neuman 2003). Total responses of the 2007 survey questionnaire consisted of 184, for a response rate of 3.2 percent; however, the questionnaire was composed of six fewer questions (out of 76 questions total for the 2008 survey), rendering some of the variables ineligible for longitudinal analysis.

Each response form was coded by a unique number for organization and tracking purposes, and to maintain anonymity. All data was placed into an Excel spreadsheet (except for answers to a handful of open ended questions) and a limited amount of specific data was transferred from the Excel format to SPSS (formerly the Statistical Package for the Social Sciences, but now known as Predictive Analytics, which will become a product of IBM).

6.6 Scoping and Screening of the Participant Pool – Parsimonious Classifications for Value Logic Classifications of Firms

The population focus of this research project is a polyglot industry (i.e., the Architecture-Engineering - Construction industry) comprised of firms that may designate their NAICS Code as being either from the service industries categories or, as in the case of some large EPC firms (Engineer-Procure-Construct) as being from construction industry categories. Interestingly, for these latter firms, the core function of the firm begins with planning and design, but because most of the money flow within these companies emanates from follow-on construction and/or facilities operation work, the core competency is frequently overshadowed by business exigency. If one subscribes to Stabell and Fjeldstad's theory of functional differences between classes of firms, a firm can be categorized based on their linear-sequential, reciprocal or pooled value logic (Stabell and Fjeldstad 1998). Earlier, Thompson had termed these firms as long-linked, intensive or mediating, and had acknowledged that companies often emphasize one of the three functional approaches, while exhibiting some aspects of the other two functional styles within their firm operations (Thompson 1967).

In keeping with the flexibility permitted by mixed methods research, this project uses a management theory to guide the research and a related theory of the firm for quantitative testing (Cresswell 2003). The guiding theory, or theoretical lens, is value logic theory, generally termed production theory in pre-Porterian terms. The companion theory (that which is quantitatively tested as part of this research) is the resource-based view of the firm, which maintains that a firm consists of heterogeneous bundles of assets, although general categories of those assets may be endemic to specific industries (Barney 1991; Hitt 1997; Youngman 2003).

A complete but parsimonious typology of firm value creation was proposed by Stabell and Fjeldstad ten years ago (Stabell and Fjeldstad 1998). This typology, later expanded and improved upon by the original proposers and other scholars, specifically places "firms that rely on intensive technology, such as medicine, law, architecture and engineering" in the value shop category (Stabell and Fjeldstad 1998; Fjeldstad and Andersen 2003; Roos et al 2005; Woiceshyn and Falkenberg 2008). While architectural and engineering firms appear to nest within the value shop categorization, this research is bounded by an industry that goes beyond planning and design to encompass general construction. Therefore, a recapitulation of the firm value logic choices is necessarily included in a chapter addressing methodology and modeling.

Porter depicted the value configuration diagram in his classic book on *Competitive Advantage* (Porter 1985). An adaptation of his diagram is reproduced here, but instead of labeling the firm's "primary activities" and "support activities" as Porter termed these value processes, the chart adopts a less hierarchical and more descriptive terminology by relabeling these activities as firm-oriented activities (implying more general firm-wide business functions) and product-oriented activities (for the specific production/operations activities of the firm, plus the upstream and downstream product-oriented functions necessary to assemble assets, manufacture products, distribute output, market and sell output, and provide service in the field).

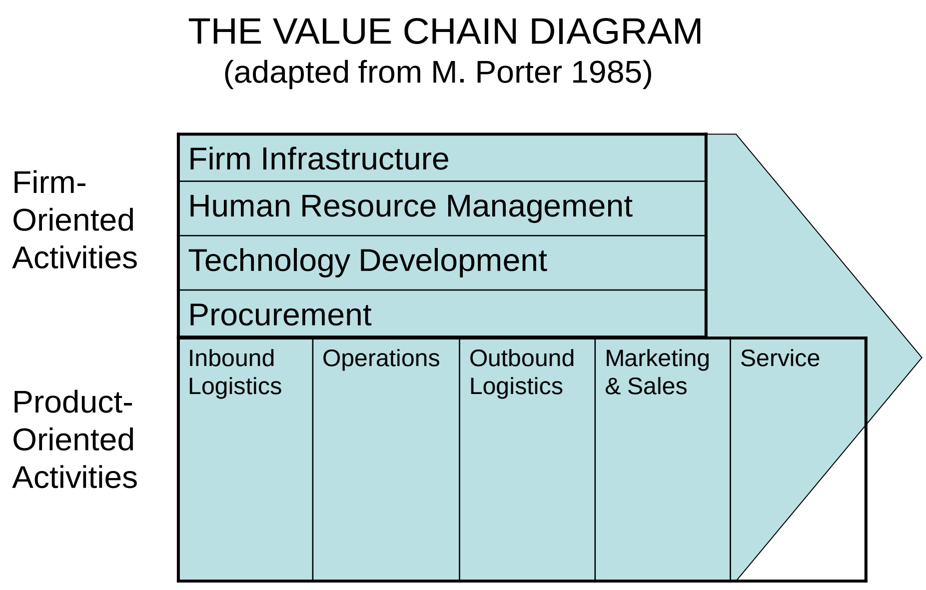


Figure 7 Value Chain Diagram Adapted from Porter

Using a similar approach to show the value logic of project-oriented firms, Stabell and Fjeldstad created a value shop diagram (Stabell and Fjeldstad 1998). The authors acknowledge that many of Porter's so-called support activities, such as human resources which are co-performed with primary activities, are crucial to competitive advantage. Rather than relegate these "crucial" activities to a lower status, they are placed as co-equal firm-oriented activities to the new project-oriented activities undertaken by value shop firms in the following chart.

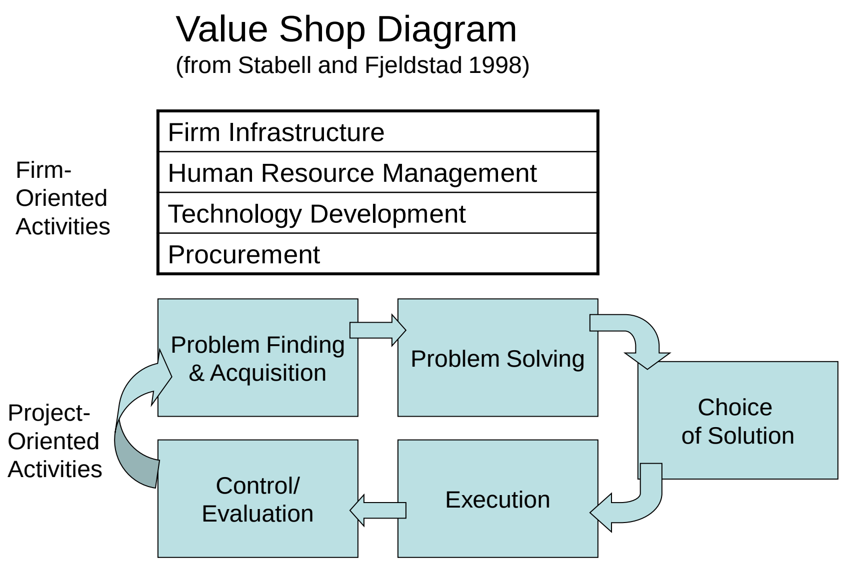


Figure 8 Value Shop Diagram Adapted from Stabell and Fjeldstad

The third primary value logic approach tries to capture the simultaneous performance of activities taking place on several layers through mediating technologies and exchange relationships (Fjeldstad and Andersen 2003). Depicting such a configuration is difficult within the two dimensions of a printed page, however the window within a window within a window metaphor provides of glimpse of the possibilities under this value logic scheme. Again within this value logic alternative, it would be disingenuous to place "technology development" as a secondary activity of a value network entity, so the Porterian primary and supporting activities have been supplanted by general firm-oriented activities and dynamic enterprise-oriented network activities (abbreviated as network-oriented activities).

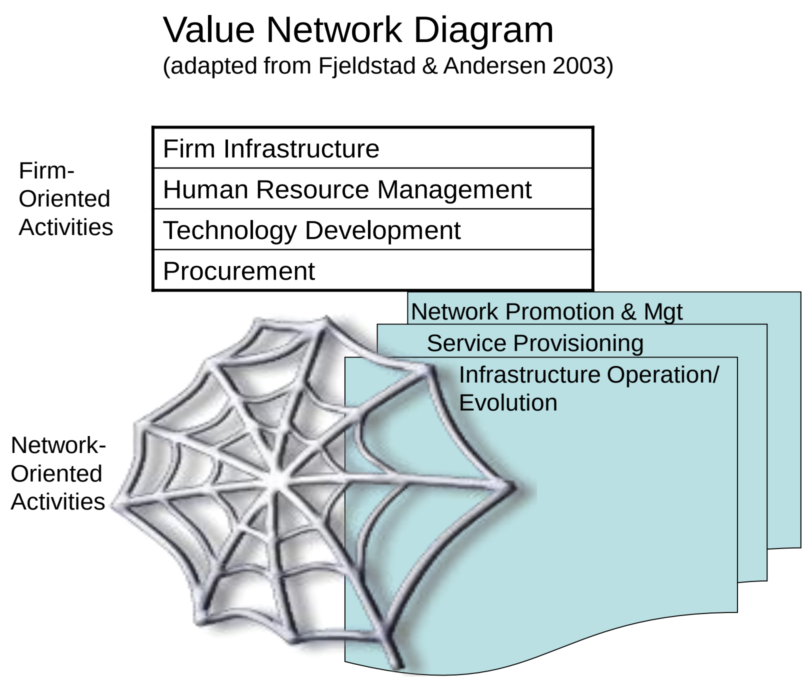


Figure 9 Value Network Diagram Adapted from Fjeldstad and Andersen

As the Department of Commerce has recognized since the 1930s, a single industrial classification (and alter ego value logic model) does not apply to every type of firm. The SIC Code and its successor NAICS code have a distinct separation between extraction, manufacturing and service firms. Construction firms under the NAICS, for better or for worse, are found under NAICS 23, and architecture and engineering are found under NAICS 54 (Professional, Scientific and Technical Services). A more complete explanation of the federally-designated sectors is found in Section 4.7 of this research paper. Using government data and the more recent value logic theories explored in this chapter, it is possible to use results of surveys of firms' assets to operationalize a Stabell-Fjeldstad classification. Lack of a classification has led to some mis-applications, such as when Porter's value chain is thrust upon value shop: the firm may incorrectly focus on standardization rather than knowledge development or use cost-based rather than value pricing (Fjeldstad and Andersen 2003). Similarly, a value chain logic would not help a value network firm, because value chain focuses on product profitability whereas the value network should emphasize a customer's lifetime participatory value, and a value chain is concerned with market share of its product (appropriate if one is producing products) but a value network is dependent on customer interaction through the mediating technology. Further evolution of these concepts and the proposed intersection between value logic theory and resource-based theory of the firm is graphically presented in the next section.

6.7 Graphic Representation of Asset-Based Concepts; Idealization of Relationships and Patterns Toward a New Model

The inexorable tide of economic change since the first industrial revolution is mentioned in Chapter 2 of this research project, with acknowledgement of the deep transformations in modes of production brought about by concentrated capital and machine tools exemplified by coal-fired steam pumps in mines and textile looms greatly expanding the rate of production of cloth over had methods. This period of technological growth, roughly from 1760 to 1830, began changing society from agrarian-based work to a mix of agriculture and extraction/manufacturing employment. The second industrial revolution began about 1860 and continued until the early 1900s, and was characterized by a great many new inventions that found their way into production, such as new chemicals, electrical motors, internal combustion engines, telegraph and radio (Chandler 1969; Landes 1969). At the same juncture, advances in interchangeable parts, assembly line production and accounting processes led to the rise of hierarchical firms and corporations in Europe and America (Hounshell 1984).

Recently, others have suggested that we are in the midst of a third industrial revolution, which began in the 1980s, and whose technologies, such as personal computers, nanotechnology and the internet, have ushered in a "New Economy" (Toffler 1981; Sveiby 1997). Some claim that the first official year of this new economic reality was 1995, which was the point at which the internet was fully realized and made available for near-universal access (Nelson 1996; Stewart 2001). Two researchers at the Brookings Institution recognized the new economy as being driven by new technologies, globalization and an increasing dependence on intangible resources, such as intellectual capital, research and development and human capital (Blair and Wallman 2001). Computers, telecommunications and data networking technologies are altering how firms, employees and managers interact and work, both within the boundary of the firm and with constituents in external environments, such as alliances, distributors and suppliers (Galbreath 2004).

A second exogenous influence upon national economies and firms operating nationally and internationally has been the accelerating spread of globalization, beginning thousands of years ago, but increasing in rapidity beginning in the 19th and 20th centuries. Globalization has been propelled, in part, because of the exploitation of comparative advantage among nations (Samuelson 1969). Globalization is characterized by world markets, free flow of goods, free flow of capital and deregulation. A danger of exportation of capital, according to a few economists, is that some countries begin functioning as if there were absolute advantage rather than relative advantage, which may place extreme competitive pressure on a country's remaining domestic industries that have higher factor input and production costs (Daly 1996; Ackerman 2001).

A third transformative influence that has emerged in the last 30 years is the concern over environmental sustainability, which questions how people can live within environmental constraints of the earth's regenerative capacity and absorption of man's impacts upon the globe's ecology. The world is moving from an era where man-made capital stocks were the limiting factor to an era where the remaining natural capital stocks are the limiting factor (Daly 1996). One shortcoming of the resource-based theory of the firm is that most of its proponents have ignored constraints imposed by the biophysical environment, and that it is necessary not only to listen to the voice of the customer but the voice of the environment (Hart 1995). Governments and firms are increasingly confronted with broader stakeholder perspectives, such as environmental, social and economic goals of communities, rather than narrower investor perspectives of profit maximization, stock growth and dividend distribution (Banerjee 2002).

The pressures of the world market, driven by technological change, globalization and environmental awareness and activities, are causing market volatility due to lower transaction costs, swifter diffusion of technologies and inabilities of firms to protect competitive advantage (Hitt 1997). Because of the unpredictability of markets where old dependencies upon traditional physical produced and financial assets fail to provide clear competitive advantages, firms are searching for other sources of asset endowment and differentiation. Where new technologies and globalization are forcing firms to react, these companies can begin to anticipate or lead change by adopting managerial and operating flexibility in an effort to continuously adapt to substantial, uncertain and swiftly-occurring changes in the marketplace (Hitt et al 1991).

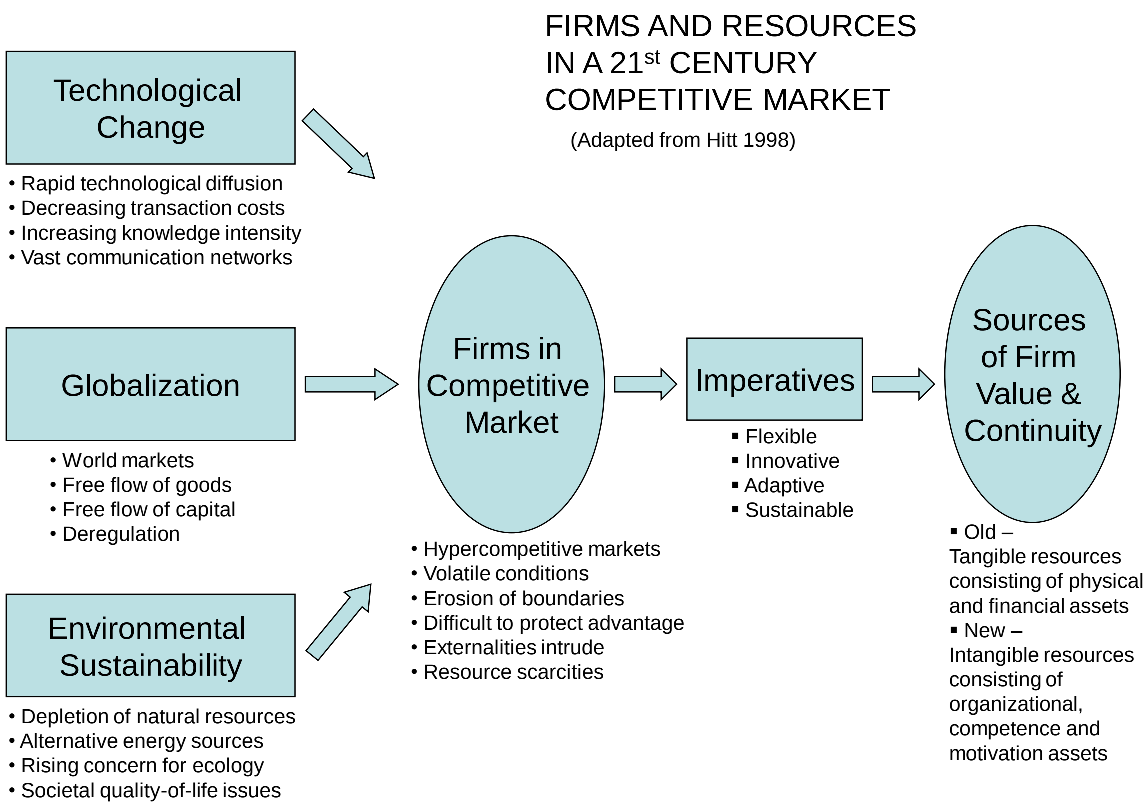


Figure 10 Firms and Resources in a 21st Century Competitive Market

Certainly not all of the resources in a firm's competitive bundle of assets are composed of traditional fixed and financial capital assets. Penrose cites endogenous services, technological bases and firm competencies in *Theory of the Growth of the Firm* (Penrose

1959). Mintzberg maintains that the appropriate fit between internal capabilities and external opportunities determines competitive advantage (Mintzberg 1990). Resources are important to the firm as it plans for future markets as well as for the economic rents that assets can generate. These rents are defined as the excess return to a resource over the opportunity cost, or as payments received above and beyond the amounts necessary to retain or to call the asset into active use (Peteraf 1993). A conceptualization of the capital assets as factor inputs into production cycles, utilizing both tangible and intangible varieties of assets, is shown in the following chart.

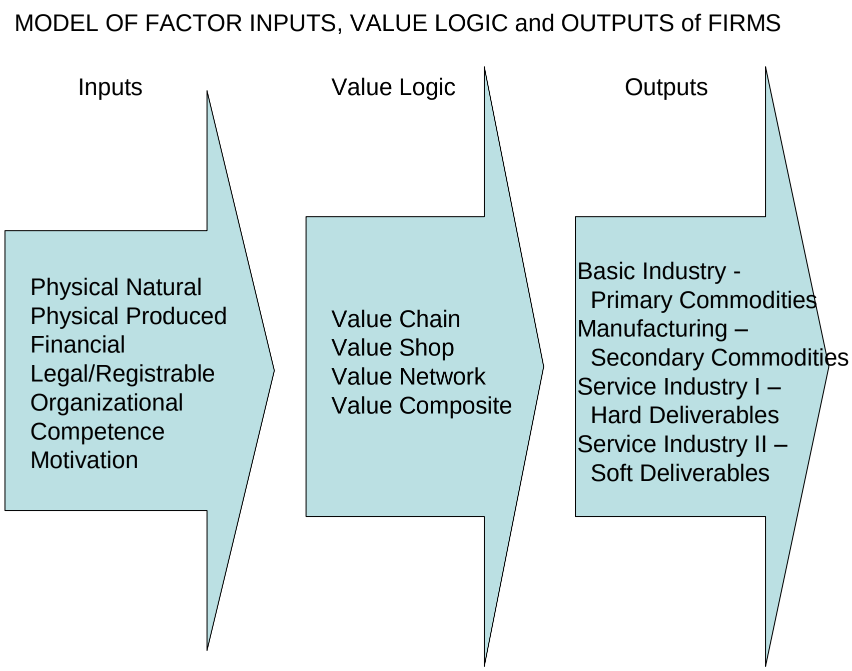


Figure 11 Model of Factor Inputs, Value Logic and Outputs

Conceptually, students of traditional economics can begin to accept the existence of intangible capital when they recognize that capital facilitates the creation of value, even if it may not possess instant value in and of itself. Some agents of production are not primarily physical or financial, but they nevertheless are used in the production process for spawning of new goods and services (Dean 2007). Drucker treated knowledge capital as a distinct form of capital that could not be substituted for by traditional forms of capital, and recommended that both traditional and human capital should receive ongoing attention and investment by management (Drucker 1985).

According to Teece, the increase and spread in the number and range of markets in which companies buy production inputs, the deregulation of financial flows and the liberalization of product and labor markets are stripping away traditional sources of competitive differentiation and exposing a new fundamental core for wealth creation. The fundamental core is the development and astute deployment of intangible assets, of which knowledge, competence and intellectual property are the most significant (Teece 1999). The actual use value of knowledge to an organization is directly dependent on the context in which it is used, which ties dynamic applications of intangible assets to firm strategy, organizational direction and the external economic environment (Mouritsen 2005).

A firm's strategy and market value are dependent on tangible physical assets as well as individual and collective human action (both leaders and employees) as true agents of the business, in order to ensure continued existence of the company (Sveiby 2001). Furu and Lehtonen build on Sveiby's framework, but the classes of intangibles are re-cast into:

Competence X Leadership & Organization X Motivation = Value Creation Potential

In order to clarify and fine-tune the contribution of Furu, this research moves Leadership assets to the Motivation group, where these related assets meet the allocation distinctions found in *Knowledge Assets – Professional's Guide to Valuation and Financial Management* (Clare and Detore 2000). The following charts are two conceptual models showing two distinct, but related perspectives of the firm. The first depicts the firm as a resource-based enterprise relying on production strategy as a guide to organize and deploy tangible and intangible assets, as well as market strategy as a guide for deployment of assets and as a plan of action for outputs of the production process. The second chart conceptualizes the firm as a bundle of assets, which is at the heart of resource-based theory.

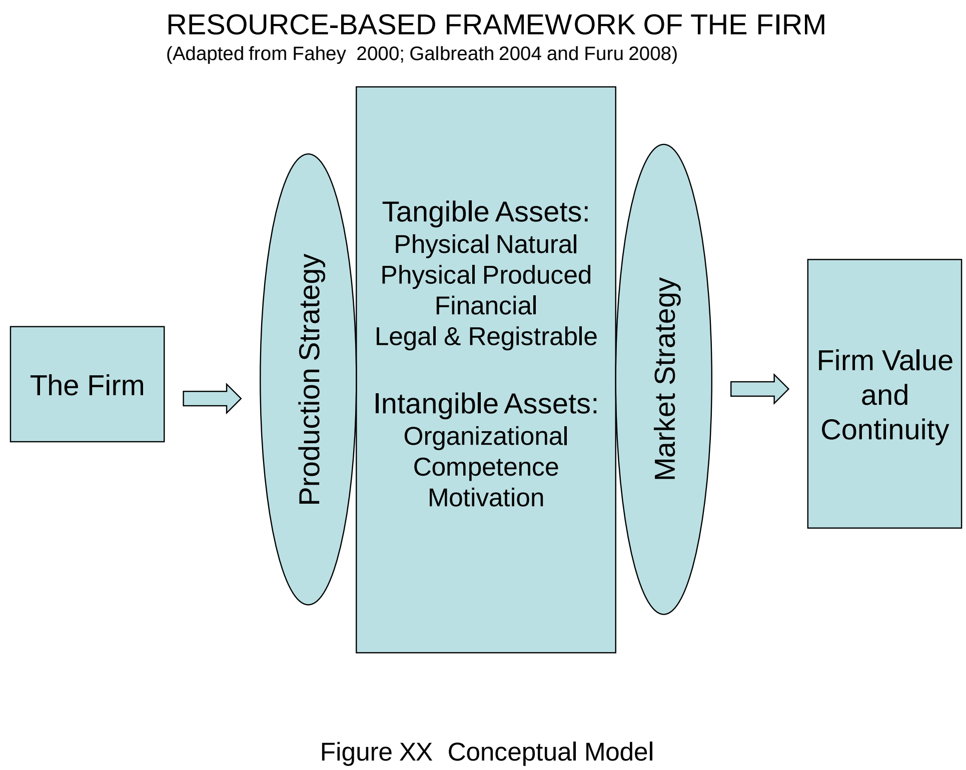


Figure 12 Resource-Based Framework of the Firm

The process flow of both charts is influenced by Prahalad and Hamel's contention that too much focus on product markets shifts management's thinking away from value creation. These researchers argued that the success of Japanese firms (such as Toyota and Honda) rested on their ability to view themselves in terms of core competencies rather than in terms of the product markets that they served (Prahalad and Hamel 1990). The firm, according to their thesis, is a bundle of constituent skills, technologies and competitive resources, which can gain a different, richer perspective on their market prospects by looking at portfolios of resources in the form of tangible and intangible asset combinations (Prahalad and Hamel 1990; Wernerfelt 1984). A few years later, Hamel and Heene took the idea a step further, arguing that a firm would typically have five to fifteen core competencies as a basis to leverage resources (Hamel and Heene 1994).

A theory of the firm needs to address two issues: why the firm exists and what determines its scale and scope (Holmstrom and Tirole 1989). Grant argues that the firm exists to integrate knowledge by way of creating conditions under which multiple individuals can integrate specialist knowledge for producing goods and services (Grant 1996). Firm-specific resources, including knowledge assets, explain performance variability among firms (Galbreath 2004). Under resource-based theory, there is emphasis on both tangible and intangible resources, but recognition that certain assets can emerge as key strategic resources thereby allowing a firm to stretch or extend its boundaries over time (Amit and Shoemaker 1993). Galbreath suggests that the new-economy scholars of the 21st century may have been overly zealous in focusing their research almost exclusively on intangible assets, implying that the more prudent researcher must respect both old-economy (tangible) and new economy (intangible) assets to account for the statistical differences among firms (Galbreath 2004). Therefore, Barney's assertion that firms are bundles of tangible and intangible resources is used as a point of departure, and as partial justification for the aggregation model shown in the next section (Barney 1991).

6.8 An Aggregation Model – A New System of Organizational Accounts Depicting Total Firm Assets – Organizational Total Asset Accounting (OTAA)

In their 2005 essay about measuring business intangibles, Corrado, Hulten and Sichel recommend the addition of computerized information (databases, programs, etc.), innovative property (inventive and creative activities), and economic competencies (knowledge embedded in firm-specific human and structural resources) to the traditional asset inventories of firms (Corrado et al 2005). According to economists of the Federal Reserve Board, intangible asset deployment may account for up to 13 percent of Gross Domestic Product (Federal Reserve 2004). Other economists think that this percentage is conservative, and that the total may be as high as 20 percent of GDP (Prescott 2005).

Just as government statisticians want to know how large the stock of tangible capital is within a country (to estimate productivity), they also want to know what the stock of intangible capital is, so as to estimate and explain differences in inputs and outputs (McGrattan and Prescott 2002). Currently unmeasured intangible capital investment is important in macroeconomic analyses; however, one needs to have an organizing template for these accounts – also known as satellite accounts – as reported from firms and industries as a method of collecting this data. Such templates have been proposed beginning with Sveiby's 1997 Assets Monitor, with the most recent by the United Nations and the US Bureau of Economic Analysis (Sveiby 1997, Jorgenson et al 2006). Those proposals, while excellent attempts at solving the data needs of specific agencies or industries, do not appear to meet the requirement for clarity of use, nor of the parsimonious model test (least complex but still observable characteristics for scientific measurement) necessary for universal application to firms, industries and national economic systems. Therefore the following aggregation model is proposed, adapted from previous attempts by researchers within the same theoretical frame, but with Furu's intangible assets organizing scheme included in lieu of some of the better known models (Furu and Lehtonen 2008).

The concepts for the seven asset categories have been adapted from Sveiby (1997), Clare and DeTore (2000), Roos et al (2005), Jorgenson et al (2006), Furu and Lehtonen (2008). They are listed here in three categories: Table 16A includes traditional physical and financial assets, Table 16B includes legal and registrable assets (which are generally included on financial statements and balance sheets, although there are some exceptions) and Table 16C that includes organizational, competence and motivational assets. A composite Organizational Total Asset Accounting spreadsheet is shown on 11 X 17 in the Appendix.

Table 16A Total Asset Accounting – Physical and Financial Assets

PHYSICAL NATURAL ASSETS	***PHYSICAL PRODUCED ASSETS***	***FINANCIAL ASSETS***
Non-Renewables:	Fixed:	Cash and Cash Equivalents:
▪ Land*	▪ Plant & Machinery	▪ Currency
▪ Minerals	▪ Buildings	▪ Deposit Accounts
▪ Metals	▪ Tools	▪ Negotiables
▪ Fossil Fuels	▪ Investment Property	
▪ Other Nonrenewable	▪ Electronic Hrdwr/Systms	Short-Term Investments
	▪ Other Phys Infrastructure	
Renewables:		Receivables
▪ Solar	Mobile:	
▪ Wind	▪ Trucks/Rolling Stock	Inventory
▪ Air**	▪ Bulk Containers	
▪ Water**	▪ Produced Materials	Pre-Paid Expenses
▪ Soil**	▪ Equipment	
▪ Biological**	▪ Furniture & Accessories	Long-Term Financial Investment:
-- Timber/Crops/Lvstck	▪ Business/Personl Proprty	▪ Bonds
-- Other Plants/Animals	▪ Original Works of Art	▪ Stocks
-- Other Biological		▪ Special Funds
		▪ Some Forms of Insurance
* partially renewable		
** partially non-renewable		

Table 16B Total Asset Accounting – Legal and Registrable Assets

LEGAL or REGISTRABLE ASSETS
Intellectual Property:
▪ Patents
▪ Trademarks
▪ Service Marks
▪ Websites/Domain Names
▪ Web Networks
▪ Copyrts/Sealed Designs
Agreements, Contracts, Projects:
▪ Franchises
▪ Licenses
▪ Contracts
▪ Projects
▪ Permits
Other Explicit and Recorded:
▪ Internal Trade Secrets
▪ Databases
▪ Recorded Explicit Knowl

Table 16C Organizational, Competence and Motivational Assets

ORGANIZATIONAL ASSETS	***COMPETENCE ASSETS***	***MOTIVATION ASSETS***
Organizational Processes:	Human Assets:	Leadership:
▪ Formal Processes	▪ Education	▪ Leadership Style
▪ Informal Routines	▪ Experienc & Tacit Know	▪ Leadership Effectiveness
▪ Research & Development	▪ Prof Skills/Proficiencies	▪ Entrepreneurial Drive
▪ Execution of Bus Strat	▪ Use of Technologies	▪ Integrity
	▪ Special Talents	▪ Stratgy Commun/Execut
Organizational Structure:	▪ Retention/Promotion	
▪ Legal Structure		Innovation and Creativity:
▪ Management Structure	Continuing Development:	▪ Degree of Innov Culture
▪ Projcts/Cntrcts Approach	▪ Training	▪ Rewards for Creativity
▪ Going Concern Value	▪ Team Experience	▪ Challgng Projs/Designs
	▪ Interaction w/ Customers	▪ Aesthet/Functn Awards
Technological:	▪ Knowl Acquis & Dissem	
▪ Adoption of IT Hardware		Purpose, Vision and Strategy:
▪ Adoption of Software	Embedded Know-How/Procedur:	▪ Firm Value Proposition
▪ Other New Technologies	▪ Sum of Indiv Know-How	▪ Articulated Vision
▪ Use of Web/Virtul Ntwks	▪ Collective Know-How	▪ Strategc Plan & Planning
	▪ Grp Routines & Proced	▪ Plan Diffus/Acceptanc
External and Relational:	▪ Deep Intracts/Mentorship	▪ Forward Reach of Plan
▪ Brand and Reputation		▪ Fit of Prod/Svc to Mkt
▪ Customers/Users	Culture and Commitment:	
▪ Outreach Measures	▪ Attitudes, Values & Trust	
▪ Repeat Customers	▪ Esprit de Corps/Loyalty	
▪ Other Goodwill	▪ Sustainable Practices	
	▪ Adaptiveness	

Note: Please see the complete Organizational Total Assets Accounting spreadsheet in the Appendix on Page XX

6.9 Identification of Key Factors/Variables and Selection of Specific Quantitative Measures – Resource Bundle Constructs

Table 17 Organizational Assets Stocks and Flows

INTANGIBLE ORGANIZATIONAL ASSETS (IO)

	Organizational Stocks	***Organizational Flows***
IO-1	Organizational Processes	
	1.1 Formal Processes 1.2 Internal Routines & Systems 1.3 Research & Development 1.4 Execution of Business Strategy	- Regular exercise of project routines - Procedures result in studies/designs - Project breakdown, assignments, handoffs - Iterative design processes practiced - Info gathering for novel solutions - Custom design solution to solve client prob - Systems to get work, do work, keep score - Ind & collective accomp of strategy & goals
IO-2	Organizational Structure	
	2.1 Legal Structure 2.2 Management Structure 2.3 Contracts/Projects Approach	- Stability of firm’s legal structure - Fit of legal structure to firm strategy -Structure effective for A/E/C operations - Handles routine probs & major challenges - Maintenance of mixed portfolio of projects - Volume & backlog equal to firm capacity

	2.4 Going Concern Value	- Ability of org to produce output for mkt - Operat value of firm minus liquidation value
IO-3	Organizational Technological	
	3.1 Adoption of IT Culture 3.2 Software Adoption 3.3 Other New Technologies 3.4 Use of Web/Virtual Networks	- Acquis & use of state-of-art hardware - Degree of use of intranets and extranets - Acquis & use of state-of-art software - Percentage of employees using said software - Adoption & use of new products & processes - Strategic/early adoption of new prods/technol - Web-enabled collab & design capabilities - Percentage of work thru web-base platforms
IO-4	External or Relational	
	4.1 Brand and Reputation 4.2 Customer Base 4.3 Outreach Measures 4.4 Repeat Customers 4.5 Goodwill	- Recognition & penetration of brand - Number of hits/depth of use on website - Actual and potential customers - Market penetration of identified base - Techniques & success rate of outreach effrts - Relational teaming w/ customers & firms - Percentage of customers repeating ea year - Attainmnt of trusted advisor status w/ clients - Percent of mkt having positive view of firm

Table 18 Competence Assets Stocks and Flows

INTANGIBLE COMPETENCE ASSETS (IC)

	Organizational Stocks	***Organizational Flows***
IC-1	Human Assets	
	1.5 Education 1.6 Experience & tacit knowledge 1.7 Professional proficncy & skills 1.8 Use of technologies 1.9 Special talents 1.10 Retention/Promotion	- Educational attainment measures - Distribution of professionals by discip & role - Years of experience - Recognition/application of tacit knowledge - Licensing/certification/specific skills - Specialized skills applied in previous term - Percent of work done thru web-enabled tech - Embrace of new product/equip/process tech - Recognized unique abilities of staff - Examples of application of unique talents - Retention of staff; voluntary/involun turnover - Track record/success of promo from within

IC-2	Continuing Development	
	2.1 Training	- Firm support/non-support of training - Hours of cont ed per yr/by level of employee
	2.2 Team Experience	- Experience of professnls working in teams - Collective team exp in selected mkts
	2.3 Interaction with customers	- Client's level of engagement in projects - Num of transactional vs relational contracts
	2.4 Knowledge mgt & acquis	- Formal firm routines of knowl acq & dissem - Examples of acq and applic of new knowl
IC-3	Embedded Know-How & Proced	
	3.1 Summation of indiv know-how	- Identif & calc of indiv employee know-how - Indiv work procedures of firm employees
	3.2 Collectiv know-how & proced	- Estim of collectiv know-how of empl groups - Collect know-how contrib. to value propos
	3.3 Group routines & procedures	- Firm-condoned group routines & proced - Grp routins & procds as indust differentiators
	3.4 Deep interaction/mentorship	- Exist/amt of mgt/employee product interact - Formal/informal mentorship of employees
IC-4	Culture and Commitment	
	4.1 Attitude, values & trust	- Exist/degree of positive empl attitudes/trust - Empl values consist w/ firm goals/pub good
	4.2 Esprit de corps & loyalty	- Employee loyalty quotient - Spirit & camaraderie for firm's mission
	4.3 Sustainable practices	- Accep & sustainable practices, triple bot line - Steps to impr environ + incr firm longevity
	4.4 Adaptiveness	- Ability of employees to adapt to bus changes - Adjust to int/ext change to help firm perform

Table 19 Motivation Assets Stocks and Flows

INTANGIBLE MOTIVATION ASSETS (IM)

	Organizational Stocks	***Organizational Flows***
IM-1	Leadership	
	1.1 Leader style for industry/firm	- Style approp for client-focused business - Style suits firm vision & purpose
	1.2 Leader effectvness – internal/ext	- Leader meets/exceeds strat goals internal/ext - Leader meets/exceeds shrt/long financ goals
	1.3 Entrepreneurial Drive	- Energy/acumen propels firm in indust & econ - Adjusts to change bus environ adroitly
	1.4 Integrity	- Unassailable bus practices and integrity - Understands/fulfills ethical obligations
	1.5 Stratgy Communic & Execution	- Effective in communicating strategy - Attains strategic goals

IM-2	Innovation and Creativity	
	2.1 Degree of Innovation 2.2 Rewards for Creativity 2.3 Challngng Projects/Design Opps 2.4 Aesthetics/Function Awards	- Culture of innovation in firm - Recognit/Celebration of levels of innov - Formal/informal process to reward creativity - Innovation clusters + "fail forward" tolerated - Seeks out design opps to broaden firm - Uses client projects to gain new knowledge - Awards for asthetic/function for firm projs - Other recognit for firm processes/products
IM-3	Purpose, Vision and Strategy	
	3.1 Firm value proposition 3.2 Articulated Vision 3.3 Strategic Plan & Planning 3.4 Diffus & Accept of Vision/Plan 3.5 Forward reach of vision/plan 3.6 Prod/services fit to emergng mkt	- Firm's functional raison d'etre - Ability/potential of firm to value-add for mkt - The why & direction of firm's bus approach - Practical & noble purposes communicated - Strat plan process in place/used annually - Fit of plan to industry bus opportunities - Shared fully, partially or not shared - Embraced, accepted by employees, investors - Number of years forward of plan - Attainable, reach-for, inspiring vision? - Increase or decrease in goodwill from prev - Fit of firm's output to current/future customer

"*Knowledge work is utterly different [than Taylorist repetition]. A lawyer is not evaluated on the number of words in her closing argument, but on how well chosen and effective they are. Professionals are measured not by the tasks they perform but by the results they achieve*."

__ Thomas A. Stewart in *Intellectual Capital: The New Wealth of Organizations*, 1997

CHAPTER 7 QUANTITATIVE ASSUMPTIONS, DELIMITATIONS AND TESTING

7.1 Evaluation of the Quantitative Constructs

Positivistic research that relies on the scientific method allows researchers to test their hypotheses and looks to objective measures of data to support findings. Use of quantitative data avoids speculation and bias, and the methods can be replicated for future studies and consequent verification or rejection (Wicks and Freeman 1998). However, experimental research may not be fully realizable in situations where lack of industry data exists, such as for intangible assets, since these are not recorded or reported on a regular basis. Instead, cross-sectional field studies can be undertaken through survey research, which are strong in realism and may be more important for studying dynamic, real-life business situations (Kerlinger 1992).

The difficulty in measuring many unobservable asset constructs, such as intangible assets, makes it hard to use secondary data with sufficient validity (Das and Teng 2000). An alternative method of capturing data is through the use of a questionnaire, or through third-party data that has been developed through the use of an accepted industry questionnaire, such as an annual survey. Some researchers have found that the questionnaire or survey approach is the only appropriate method for gathering data to address strategy-related research questions (Slater 2004).

Operationalization of a construct involves describing its characteristics in order that it may be measured (Sekaran 2000). Generally, tangible assets are categorized as either physical assets or financial assets (Boulton et al 2000). Assets that contain physical properties and can be seen or touched are captured in the firm's financial statements, and are represented on the statements with an accounting-based monetary value. Physical assets are often depreciated, amortized and/or written off at the end of their useful life. Financial assets are made up of a firm's current assets as are listed as cash or are capable of being converted into cash (Vause 2001).

Intangible resources are harder (or impossible) to observe and largely non-codifiable making it difficult for a researcher to measure them (Reed and DeFillippi 1990). However, difficulties in operationalizing intangible assets should not impede empirical tests (Godfrey and Hill 1995). In order to study a firm's intangible assets, one must empirically verify patterns in populations of firms to corroborate researchers' conjectures about the existence and sustainability of alleged advantages (Levitas and Chi 2002). Blending theoretical and conceptual precedent, four constructs have been posited to represent dimensions of intangible resources: 1) Legal and Registrable; 2) Organizational; 3) Competence; and 4) Motivational (Williamson 1985, Barney 1986, Becker and Huselid 1998, Grant 2002).

An increasing volume of research on corporate turnarounds and organizational transitions has revealed research interests in organizational performance, adaptation and survival (Venkatraman and Ramanujam 1986). In their strategy-based anthology *Organizational Effectiveness*, Cameron and Whetten suggest that "Constructs such as intelligence, motivation or leadership, whose construct space, by definition, are not bounded, have been better understood as limited aspects of their total meaning…and in assessing organization effectiveness, a similar attack seems appropriate; that is, to concentrate on measuring limited domains of the construct" (Cameron and Whetten 1983).

One of the key objectives of the study is to test whether differing asset deployment strategies by firms results in greater continuity or longevity when compared to other firms providing data (Phase II of this multiple methods approach). A second key objective is to attempt to draw distinctions between tangible assets (physical and financial assets) and intangible assets (organizational, competence and motivation) to see if simplified combinations of individual tangible and intangible assets would result in a benefit or market advantage to specific classes of firms (Phase I quantitative analysis in this chapter).

To satisfy these objectives, use of bivariate analysis and cross-tabulation are employed. Cross-tabulation can help to analyze the relationship between independent and dependent variables, or between defined problems and factors contributing to those problems. By looking at the extent to which one variable (the cause) influences another variable (the effect), the researcher can investigate cause-and-effect relationships (Leedy and Ormrod 2005). While bivariate analysis and cross-tabulation provide information about the relationship of two variables, these techniques does not address the strength of the relationships, and further review may be essential. However, the descriptive statistics shown in earlier chapters of this study have practical and orientational value that appear to have been beneficial to industry reviewers and the Delphi expert panel assembled for this research project.

7.2 Testing of the Hypotheses

Real world problems may be too complex to be directly analyzed and therefore studies undertaken by researchers are usually abstractions of such real world problems (Smith 2008). Investigative research is often investigated by taking a simplified view of the problem, using data directly obtained or from reliable sources, and focusing on a particular point-of-view to analyze the problem. Quantitative research addresses a problem by testing a hypothesis or theory composed of variables, which are analyzed with statistical procedures to determine whether the hypothesis or theory holds true (Cresswell 2003).

In this phase of the research, a quantitative approach is employed beginning with descriptive statistics of the dataset variables, followed by cross-tabulation among the variables to determine whether correlations exist. Using a quantitative approach to test relationships is regarded as acceptable if such data (including data from third party surveys) is reliable. Testing of hypotheses using quantitative analysis is supported by a variety of software programs available to university researchers, including Microsoft Excel, RExcel, MATLAB and SPSS. For purposes of this phase of the research, Microsoft Excel XP has the capability of generating tabulated reports, charts, plots of distributions, trends and cross tabulations.

Univariate statistics, while useful, simply describe a single variable in isolation. For researchers, bivariate statistics are more valuable since they allow relationships to be described between two variables as found in a basic hypothesis (Neuman 2003). Descriptive results with single variables are found in a number of earlier chapters, usually expressed through frequency distributions shown histograms, bar charts or tables. Where useful, variations in frequency distributions are also described by calculating standard deviation from the mean score to show homogeneity or heterogeneity among respondent answers.

The statistical relationships shown in Section 7.4 of this chapter are based on the range between covariation and independence. To covary means to vary together; cases with certain values on one variable are likely to have certain values on the other one; whereas independence is the opposite of covariation, meaning that there no relationship or association between variables (Neuman 2003). Most hypotheses are expressed in the form of a causal relationship, or expected covariation. To help to decide whether relationships exist based on the expressed hypotheses in this phase of the research, scattergrams, graphs or plots are used. As discussed in new next section however, it is recognized that bivariate relationships may be spurious, so the introduction of control variables, use of multivariate analysis, critical review of sample size/richness, and careful observation/interpretation are also important before accepting or rejecting a hypothesis.

7.3 Verifying the Approach in Terms of Relative Accuracy and Reliability

For purposes of understanding the degree to which sample means will agree with the corresponding population mean, it is useful to consider what would happen if six or 60 separate sampling studies of the same type were conducted. If the results were consistent across multiple studies, then confidence could be placed in the single sample. But if answers from repeated samples were highly variable, it would suggest that a different sampling approach or a larger sample size would be needed (Arsham 2009).

Despite best practices in designing and conducting surveys, errors can be introduced due to use of an inadequate time frame, poorly designed questions, recording and measurement errors and non-response problems. However, the theory and methods of estimating survey non-sampling bias are underdeveloped (Lehtonen and Pahkinen 2003). Another source of error can be introduced by relying on data from managers responding to surveys in which they exaggerate or otherwise introduce bias into their performance levels. This potential survey error can be mitigated by examining data from both primary and secondary sources and seeing if results are generally in agreement (Venktraman and Ramanujam 1986).

Reliability examines whether the measurement of a given construct can be repeated; or whether the measurement of a construct can be repeated over time instead of it being a random event (Hair et al 1995). Some scholars have suggested that a reliability coefficient as low as .60 are acceptable for hypothesis testing (Slater 1995). Construct validity refers to the totality of evidence about whether an operationalization of a construct adequately represents what is intended by theoretical description and measurement, and whether the element is valid based on relating it to another element that has been recognized as being valid (Cronbach and Meehl 1955). Stated another way, construct reliability tests the degree to which individual items used in a construct are consistent in terms of their measurement (Nunnally 1978).

Convergent validity refers to the degree by which a measure is correlated to other measures with which it is theoretically predicted to correlate; whereas discriminant validity (or divergent validity) describes the degree by which the operationalization does not correlate with other operationalizations with which it should not be (theoretically) correlated (Cronbach and Meehl 1955). Convergent validity tests the degree that items designed to load on the same construct do, in fact, load onto that construct (Carmines and Zeller 1979). Discriminant validity tests the degree to which items measuring one construct related exclusively to the construct and not to another (Churchhill 1991). Generally, research design is authenticated when a study exhibits a degree of support for the conclusion that the causal variable caused the effect (Campbell and Stanley 1963).

Achieving perfect reliability and validity in measurement is unlikely, but the two goals can be held up as ideals in the research process. Reliability means dependable or consistent, and there are three types: first, stability reliability refers to using a measure that provides the same answer when applied in different time periods; second, representative reliability answers whether the indicator delivers the same answer when applied to different persons or groups; and third, equivalence reliability applies when multiple specific measures are used in the operationalization of a construct to determine is a measure yields consistent results across different indicators (Bohrnstedt 1992). To improve the reliability of measures, one must clearly conceptualize constructs by eliminating ambiguous or distracting information, use more precise levels of measurement, formulate multiple indicators for a single measurement (called sampling from the conceptual domain), and by using pretests, pilot studies or repeating measures that have been used in previous research (Neuman 2003). Reliability (dependable measurement) is easier to achieve than validity (true measurement), but the two are normally complementary concepts.

7.4 Selected Hypotheses and Measurements:

H1A – Firms with longer term strategies (as evidenced by their strategic planning horizon) will have greater continuity or longevity.

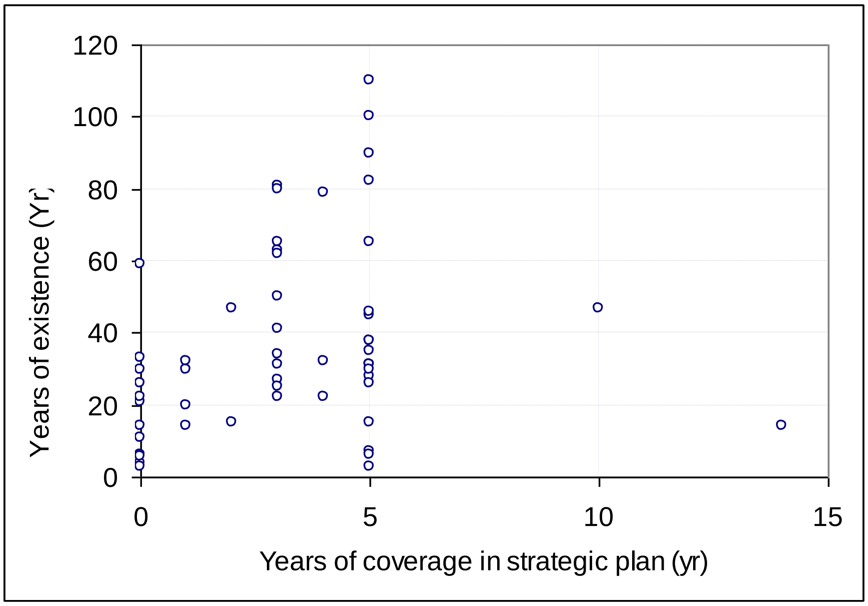


Figure 13 Plot of Years of Strategic Plan and Years of Existence of Firm

H1B – Firms with longer term strategies (as evidenced by their strategic planning horizon) will have greater profitability.

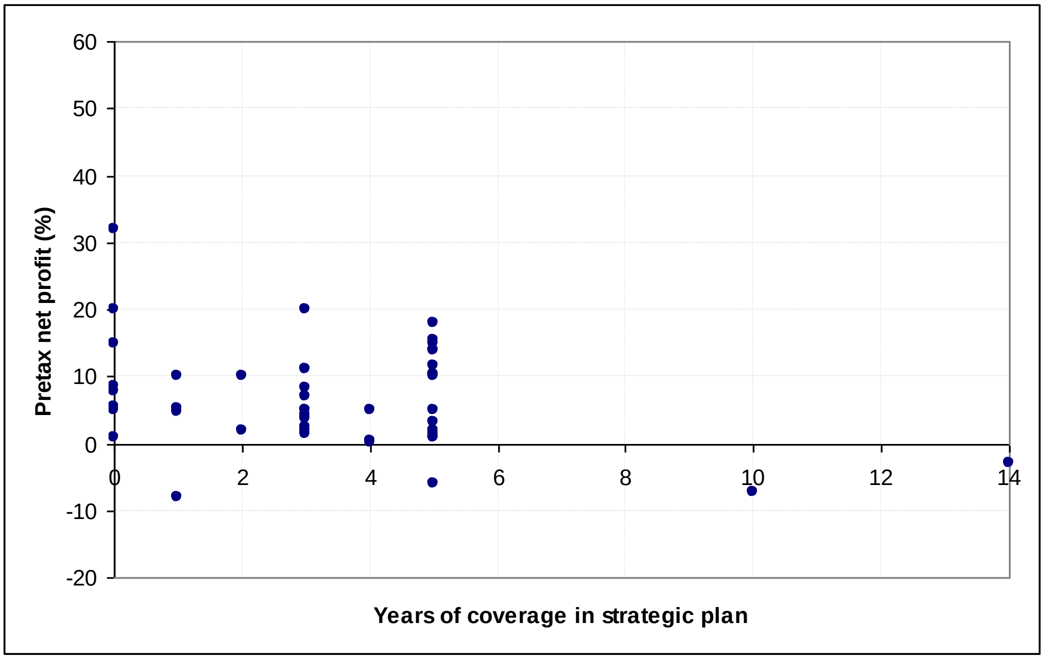


Figure 14 Plot of Years of Strategic Plan and Pre-Tax Net Profit

H2A – Firms that provide for annual continuing education hours for their employees tend to have higher margins.

Table 20 ***Hours of continuing education recommended for technical and professional staff each year (2009 ACEC Industry Trends Survey)***

0 to 8 hours	4.95 %
9 to 16 hours	21.78 %
17 to 24 hours	21.78 %
25 to 32 hours	9.90 %
33 to 40 hours	8.91 %
More than 40 hours	1.98 %
No prescribed # of hours	30.69 %

Table 21 ***Net Profit Before Taxes (ACEC Industry Trends Survey 2007 – 2009)***

MARKET SECTOR	2007	2008	2009
Transportation	8.83 %	8.74 %	9.04 %
Water/Wastewater	11.37 %	10.61 %	8.30 %
Buildings – Comm & Indust	16.24 %	11.05 %	7.50 %
Industrial & Process	N/A	11.59 %	9.94 %
Environmental (Other than water)	8.36 %	11.70 %	7.11 %
Residential	15.6 %	14.20 %	6.55 %

Energy & Power	N/A	11.52 %	4.81 %

Results (based on data from 2008 and 2009):

Table 22 Net Profit Before Taxes versus Hours of Continuing Education

Continued education hours	Pretax Net Profit percentage	Sample size
0 to 8 hours	7.92%	8
9 to 16 hours	10.71%	67
17 to 24 hours	12.74%	38
25 to 32 hours	11.91%	19
33 to 40 hours	10.02%	23
More than 40 hours	24.33%	3
No prescribed # of hours	8.07%	82

Table 23 Continuing Education of 8 Hours More or Less and Pre-Tax Profit

Continued education hours	NetProfit Pretax (%)
8 hours or less	7.92%
more than 8 hours	11.54%

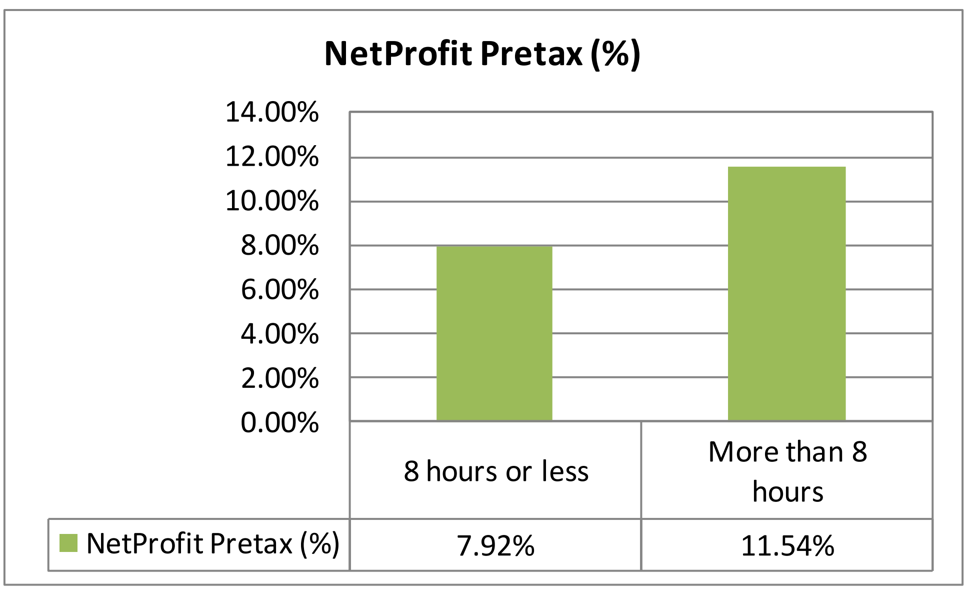


Figure 15 Chart of Net Pre-Tax Profit and Hours of Continuing Education

Table 24 Continuing Education of 2 Days More or Less and Net Pre-Tax Profit

Continued education hours	NetProfit Pretax (%)
2 days or less	10.41%
More than 2 days	12.22%

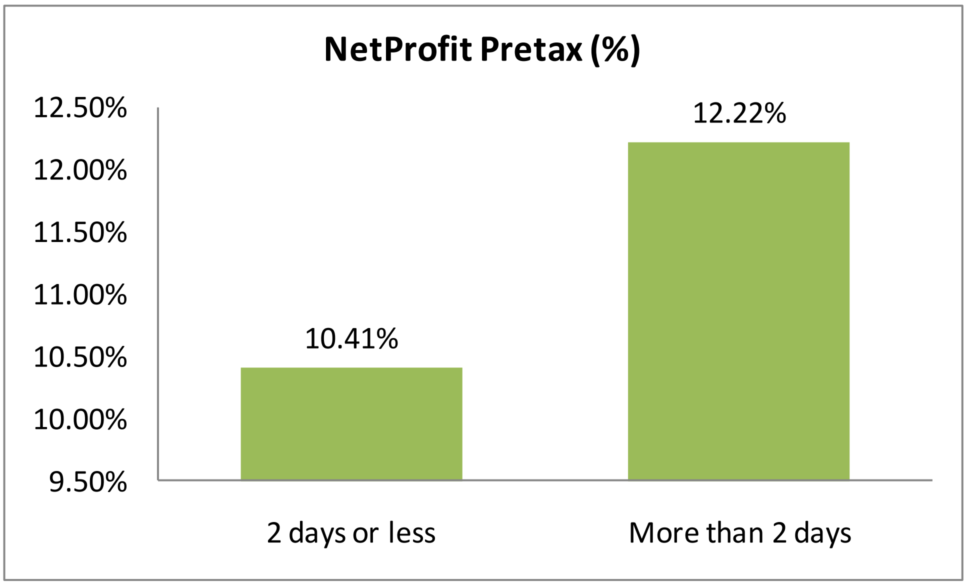


Figure 16 Chart of Two Days of Continuing Education (More or Less) and Net Pre-Tax Profit

Table 25 ***Hours of continuing education recommended for technical and professional staff each year (2009 ACEC Trends Survey)***

0 to 8 hours	4.95 %
9 to 16 hours	21.78 %
17 to 24 hours	21.78 %
25 to 32 hours	9.90 %
33 to 40 hours	8.91 %
More than 40 hours	1.98 %
No prescribed # of hours	30.69 %

Table 26 ***Net Profit Before Taxes by Market Sector (ACEC Industry Trends Survey 2007 – 2009)***

MARKET SECTOR	2007	2008	2009
Transportation	8.83 %	8.74 %	9.04 %
Water/Wastewater	11.37 %	10.61 %	8.30 %
Buildings – Comm & Indust	16.24 %	11.05 %	7.50 %
Industrial & Process	N/A	11.59 %	9.94 %
Environmental (Other than water)	8.36 %	11.70 %	7.11 %
Residential	15.6 %	14.20 %	6.55 %
Energy & Power	N/A	11.52 %	4.81 %

The original data for Hypothesis H2A can be grouped into two independent samples. One (Sample 1) contains the responses from firms offering a day or less continuing education and the other (Sample 2) contains responses from firms offering more than one day (8 hrs) continuing education hours. The response is the net profit before taxes. That is:

x: the hours of continuing education hours
y: the net profit before taxes
The hypothesis test:
H_0: $\mu_1 = \mu_2$ (hours of annual continuing education hours doesn't influence corporation margins)
H_A: $\mu_1 < \mu_2$ (providing longer hours of continuing education hours leads to better corporation margins)

This is a two means independent samples with unknown standard deviations that may be unequal. A modified *t* test, like Hsu's method, shall be used.

The test statistic

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

P value is used to determine whether we should accept the null hypothesis.

- x1 is a sample from the population of firms offering 8 or less continuing education hours;
- x2 is a sample from the population of firms offering more than 8 continuing education hours

Table 27 Modified *t* Test for P Values (Continuing Education)

Hypothesis Test	X1	X2	p value
1	Firms offering 8 hours or less continuing education hours	Firms offering more than 8 hours continuing education hours	0.077
2	Firms offering 16 hours or less continuing education hours	Firms offering more than 16 hours continuing education hours	0.137
3	Firms offering 24 hours or less continuing education hours	Firms offering more than 24 hours continuing education hours	0.379
4	Firms offering 32 hours or less continuing education hours	Firms offering more than 32 hours continuing education hours	0.436

Since all the p values are larger than the significance level of 0.05 we have to accept the null hypotheses or reserve judgments. There is no significant difference in a firm's pretax revenue by offering different hours of continuing education.

Below is the second attempt to compare any two samples with a certain interval of continuing education hours. It did not change the conclusion reached in the above graph, likely due to the constrained sample size.

Table 28 Comparison with Breakdown of Intervals (Continuing Education)

Test	xi	Sample size
1	Firms offering 0 to 8 hours continuing education	8
2	Firms offering 9 to 16 hours continuing education	67
3	Firms offering 17 to 24 hours continuing education	38
4	Firms offering 25 to 32 hours continuing education	19
5	Firms offering 33 to 40 hours continuing education	23
6	Firms offering More than 40 hours continuing education	3

Table 29 Resulting p Values from Test

Treatments	Null hypothesis	Alternative hypothesis	p
x1, x2	$\mu_1 = \mu_2$	$\mu_1 < \mu_2$	0.145
x1, x3	$\mu_1 = \mu_3$	$\mu_1 < \mu_3$	0.046
x1, x4	$\mu_1 = \mu_4$	$\mu_1 < \mu_4$	0.121
x1, x5	$\mu_1 = \mu_5$	$\mu_1 < \mu_5$	0.226
x2, x3	$\mu_2 = \mu_3$	$\mu_2 < \mu_3$	0.163
x2, x4	$\mu_2 = \mu_4$	$\mu_2 < \mu_4$	0.337
x2, x5	$\mu_2 = \mu_5$	$\mu_2 < \mu_5$	0.625
x3, x4	$\mu_3 = \mu_4$	$\mu_3 < \mu_4$	0.609
x3, x5	$\mu_3 = \mu_5$	$\mu_3 < \mu_5$	0.879
x4, x5	$\mu_4 = \mu_5$	$\mu_4 < \mu_5$	0.732

H2B – Firms that provide for annual continuing education hours for their employees tend to have greater continuity or longevity.

Results (based on data from 2009 ONLY):

Table 30 Years of Existence versus Hours of Continuing Education

Continued education hours	Years of existence	Sample size
0 to 8 hours	34.20	5
9 to 16 hours	23.95	22
17 to 24 hours	30.07	22
25 to 32 hours	28.56	9
33 to 40 hours	28.78	9
More than 40 hours	54.50	2
No prescribed # of hours	40.94	31

Table 31 Summary of Continuing Education Hours (8 Hours More or Less) and Firm Years of Existence

Continued education hours	Years of Existence
8 hours or less	34.20
More than 8 hours	28.34

Figure 17 Chart of Years of Firm Existence and Continuing Education

Table 32 Summary of Continuing Education Hours (2 Days More or Less) and Firm Years of Existence

Continued education hours	Years of Existence
2 days or less	25.85
More than 2 days	30.63

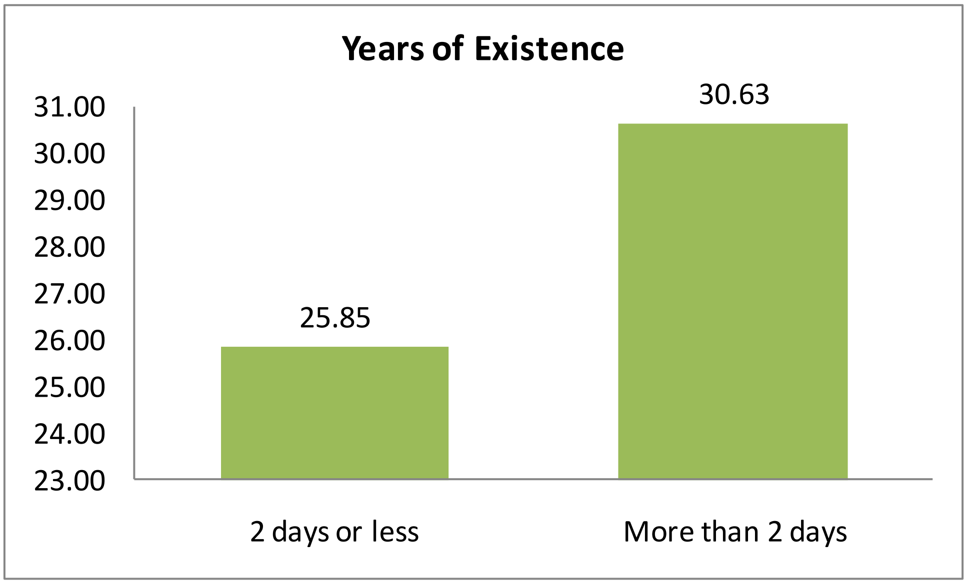


Figure 18 Chart of Firm Years of Existence and Continuing Education Hours (2 Days More or Less)

H3A – Firms with greater focus on sustainable practices will have more favorable quick ratios (liquidity).

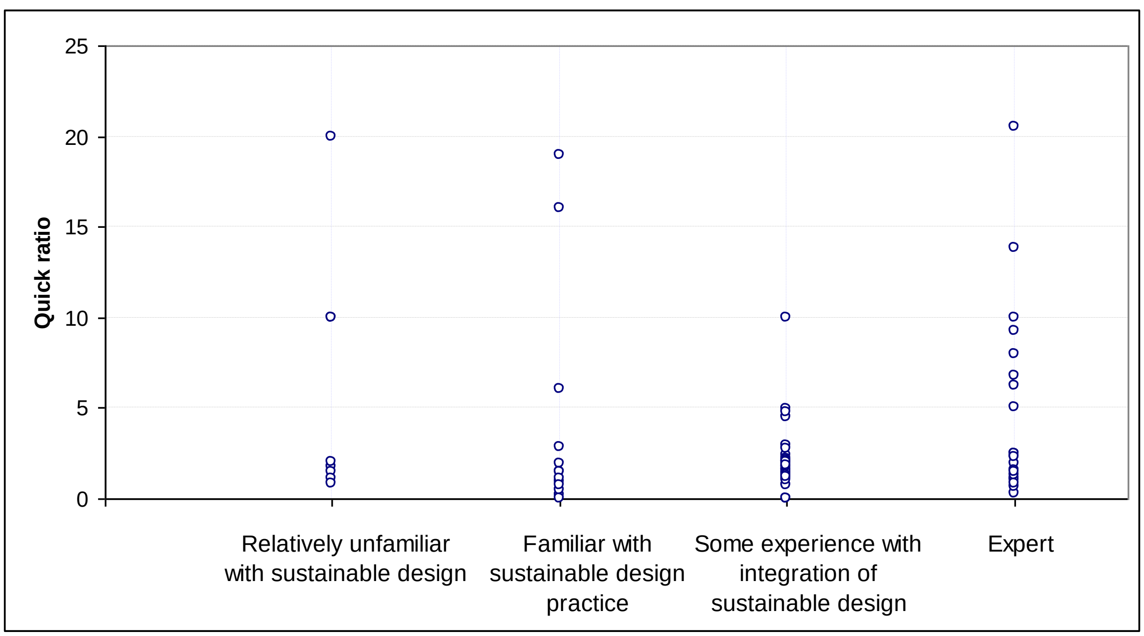


Figure 19 Plot of Focus on Sustainable Practices and Quick Ratios

H3B -- Firms with greater focus on sustainable practices will have greater continuity or longevity.

Results (based on data from 2009 ONLY):

Table 33 Firm Focus on Sustainable Practices and Years of Existence

	Years of Existence		
	Mean	Max	Min
Relatively unfamiliar with sustainable design	17.64	46	2
Familiar with sustainable design practices	26.04	60	2
Some experience with integration of sustainable design	34.94	110	3
Expert at integrating sustainable design practice	42.29	110	3

Figure 20 Chart of Years of Firm Existence and Focus on Sustainable Practices

H4A – Firms emphasizing interdisciplinary professional practice will have greater per capita revenue.

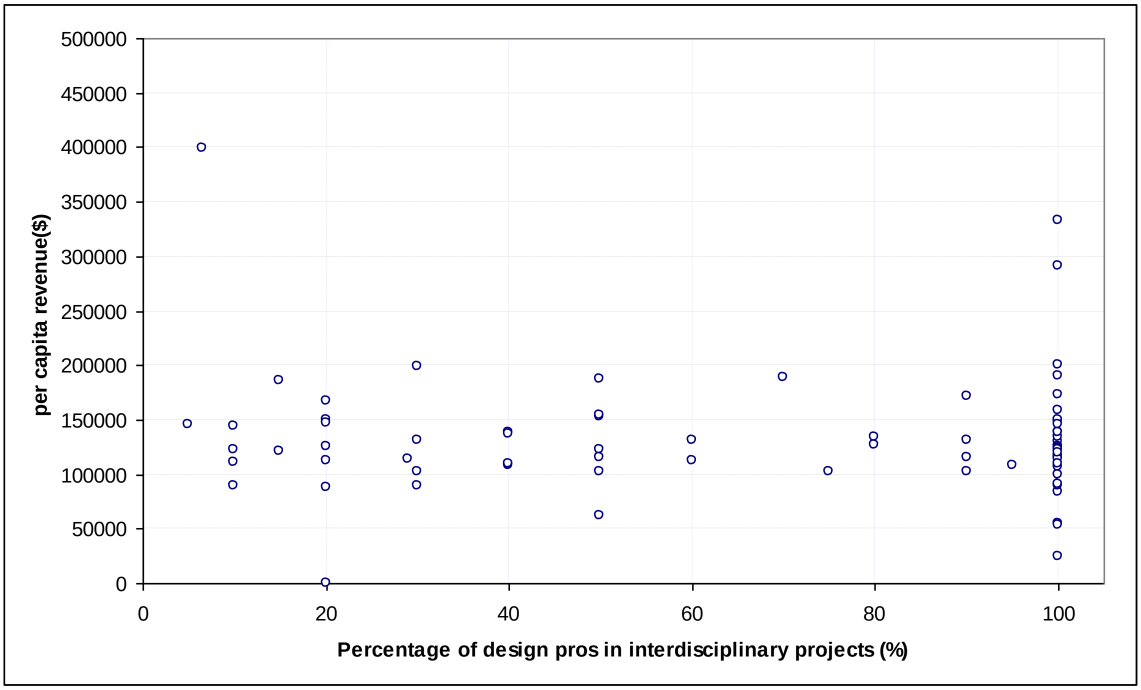


Figure 21 Plot of Percentage of Design Professionals in Interdisciplinary Practice and Per Capita Revenue

H4B – Firms emphasizing interdisciplinary professional practice will have greater continuity or longevity.

Results (based on data from 2009 ONLY):

Table 34 Firm Years of Existence and Percentage of Professionals Involved in Interdisciplinary Practice

Percentage of people in interdisciplinary professional practice	Average years of existence	nsample
0% - 10%	24.42	25
10% - 20%	39.40	10
20% - 30%	37.80	5
30% - 40%	37.50	4
40% - 50%	36.56	9
50% - 60%	26.50	2
60% - 70%	32.00	1
70% - 80%	28.25	4
80% - 90%	35.50	4
90% - 100%	33.52	33

As shown in the table above, there are some ranges within which the sample size is relatively small and doesn't have any statistical meaning. Reorganize the table as the following:

Table 35 Average Years of Firm Existence and Four Percentage Categories of Professionals Involved in Interdisciplinary Practice

Percentage of people in interdisciplinary professional practice	Average years of existence	nsample
0%~30%	29.84	40
30% ~60%	35.47	15
60%~90%	31.89	9
90%~100%	33.52	33

There are still quite a lot of differences in sample size among different levels of percentage employees working in interdisciplinary professional practice. The following table shows average years of existence at different levels of interdisciplinary practice in a cumulative sense.

Table 36 Average Years of Firm Existence and Ten Categories of Percentages of Professionals Involved in Interdisciplinary Practice

Percentage of people in interdisciplinary professional practice	Average years of existence
10% or less	24.42
20% or less	28.70
30% or less	29.84
40% or less	30.53
50% or less	31.56
60% or less	31.37
70% or less	31.38
80% or less	31.18
90% or less	31.45
100% or less	32.15

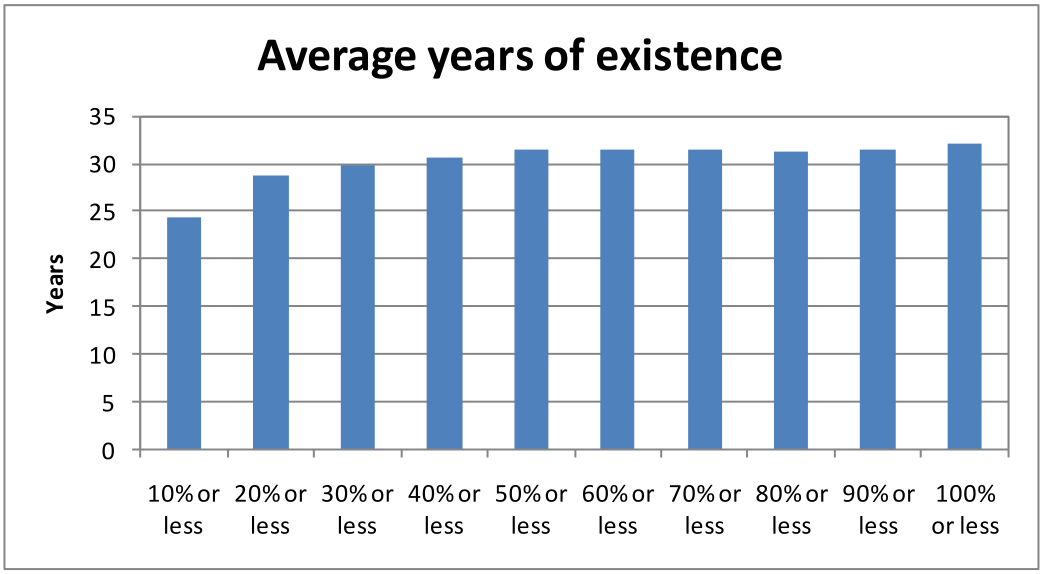


Figure 22 Years of Firm Existence and Percentages of Professionals Involved in Interdisciplinary Practice

H4C – Firms seeking out and adopting new technologies will have greater pretax net profit performance.

Results (based on data from 2009 and 2008):

Table 37A Adoption/No Adoption of New Technologies and Pre-Tax Profit

	Average Net Profit PreTax (%)	Sample Size
No adoption of new technologies	11.61	77
With adoption of new technologies	9.46	145

Results (based on data from 2009 only):

Table 37B Adoption/ No Adoption of New Technologies and Pre-Tax Profit

	Average Net Profit PreTax (%)	Sample Size
No adoption of new technologies	12.20	17
With adoption of new technologies	8.14	50

Results (based on data from 2008 only):

Table 37C Adoption/No Adoption of New Technologies and Pre-Tax Profit

	Average Net Profit PreTax (%)	Sample Size
No adoption of new technologies	11.44	60
With adoption of new technologies	10.15	95

The results do NOT support the hypothesis.

H4D – Firms seeking out and adopting new technologies will have greater continuity and longevity.

Results (based on data from 2009 only):

Table 38 Adoption/No Adoption of New Technologies and Age of Firm

	Sample Size	Average years of existence
No adoption of new technologies	19	23.16
With adoption of new technologies	60	33.96

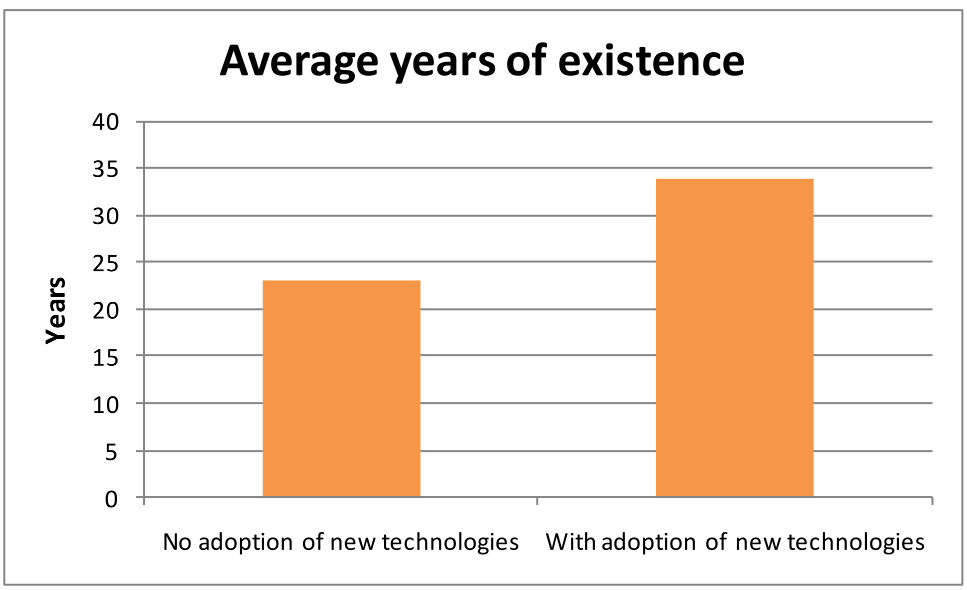


Figure 23 Adoption/No Adoption of New Technologies and Average Years of Firm Existence

7.5 Measurement Limits and Constraints

A lack of commonly agreed-upon definitions for intangible assets among researchers makes any foray into this area of inquiry more difficult as compared to more mature fields. The underlying “ultimate” resources that lead to firm value and strategic success may never be conclusively determined (Collis 1994). J.B. Barney also pointed out the difficulty in finding links between resources controlled by the firm, because the resources may be unique, idiosyncratic and largely unobservable, and therefore not possible to test unless many controlled and systematic attempts are undertaken (Barney 1991). For this research, a simplified and pragmatic approach -- rather than an exhaustive and faultless approach -- is used to conceptualize, formulate and analyze a subset of the infinite number of operating styles and firm-based tangible and intangible assets implemented through those operating styles.

A statistical process used to view the nature of relationships among variables is *correlation* (Leedy and Ormrod 2005). A correlation may exist if on variable increases (or decreases) when another variable decreases (or increases) in a predictable manner, which is then known as a bivariate measure of the association between two variables (Garson 2008). Correlation is often shown in terms of its square (r squared) and is sometimes discussed as “Pearson’s r” or correlation coefficient, which is a number between -1 and +1 (Leedy and Ormrod 2005).

Correlation can refer to the departure of two or more random variables from independence; that is, where those random variables do not satisfy a mathematical condition of probabilistic independence (Rodgers and Nicewander 1988). A common measure of dependence between two quantities is the Pearson product-moment correlation coefficient, which is obtained by dividing the covariance of two variables by the product of their standard deviations. A Pearson correlation is obtained only if both of the standard deviations are finite and both a non-zero, with the Pearson correlation of +1 achieving a perfect positive (increasing) linear relationship and -1 being the case of a perfect decreasing (negative) relationship. If the calculated coefficient is closer to +1 or -1, the stronger the correlation between the variables. As the coefficient approaches zero, there is less of a relationship; that is, the variables are approaching non-correlation (Rodgers and Nicewander 1988).

Correlation analysis can also show the likelihood that the direction and strength of a relationship between variables occurs by chance. If the relationship is statistically significant, it is unlikely to have occurred by chance; and this significance is depicted by using the Greek symbol for alpha (*a*). Although researchers differ about what standards should be used to determine whether a correlation occurs by chance, many use a 1-in-20 probability, which indicates that any result will occur by chance only five percent (0.05) of the time, and others recommend a more exacting 1-in-100 probability, wherein the result would occur by chance only one percent (0.01) of the time (O'Sullivan and Rassell 1999). Another common test of relationships between variables is the two-tailed test, which reveals the chance that the observed correlation is significantly different from the zero correlation in a positive or negative direction. A two-tailed test is intended to show the absolute magnitude of the correlation (Garson 2008).

Correlation measures are generally sensitive to the manner in which variables x and y are sampled, with the expectation that dependencies are stronger if viewed over a wider range of values. Wise statisticians remind novice researchers that "correlation does not imply causation" and cannot be used to infer causal relationships between variables (Aldrich 1995). A second corollary concerning correlations says that correlation coefficients indicate the strength of relationships between variables, but the computed value does not completely characterize the relationship. Some distributions are linear and some are not linear but may still exhibit an obvious relationship. Therefore, summary statistics such as correlation coefficients cannot replace individual examination of the data, especially where the data does not follow a normal distribution (Rodgers and Nicewander 1988).

Researchers also want to estimate the odds that sample results are produced by random error in random sampling. Statistical significance shows that particular outcomes are more or less probable; however, results can be statistically significant but theoretically meaningless if logical connections between two variables do not exist (Neuman 2003). The level of statistical significance (often .05 or .01) is a way of determining the likelihood that results are due to chance factors; or stated another way, that a relationship appears in the sample when there is none in the population. At the .05 level, for example, results are due to chance factors only 5 in 100 times, and as a corollary, there is a 95 percent chance that the sample results reflect the population accurately. The scientific community has informally agreed that .05 is a reasonable rule of thumb for most purposes, because of the trade-off between making Type I and Type II errors. A Type I error occurs when the researcher says that a relationship exists when in fact none exists; and a Type II error occurs when a researcher says that a relationship does not exist, when in fact it does (Neuman 2003).

7.6 Data Analysis and Relationships

Table 39 Summary of Hypotheses and Results Based on Quantitative Data

HYPOTHESES	**RESULTS OF ANALYSES based on quantitative data**
H1A – Firms with longer term strategies (as evidenced by their strategic plans) will have greater continuity or longevity	**Partially supported** – Although not a strong indicator, firms strategic plan horizons with multi-year coverage (three to five years) were plotted as having slightly longer terms of existence.
H1B – Firms with longer-term strategies (as evidenced by their strategic planning horizon) will have greater profitability	**Inconclusive/Not supported** – Although one could try to make the case that the hypothesis was partially supported, given the slight upward gradient of the curve, the overall plot was weak, perhaps due to the declining economy from 2007 to 2010.
H2A – Firms that provide for annual continuing education hours for their employees tend to have higher margins	**Not supported** – Despite some raw comparisons showing that firms with fewer recommended continuing education having slightly less pretax profit when compared to firms with higher levels of continuing education, there is no significance difference in pretax revenue using a modified *t* test (such as Hsu's method).

H2B – Firms that provide for annual continuing education hours for their employees tend to have greater continuity or longevity	**Not supported** – Results of this test were mixed; with years of existence compared against continuing education hours, there was no observable trendline.
H3A – Firms with greater focus on sustainable practices will have more favorable quick ratios (liquidity)	**Partially supported** – This hypothesis test revealed a plot that appears to establish a curve that shows that as firms realize greater experience in design-build, those firms tend to have higher liquidity. The problem with this hypothesis is its lack of germaneness to the other results.
H3B – Firms with greater focus on sustainable practices will have greater continuity or longevity	**Partially supported** – Although the sample size was not large, as firms gained more familiarity with sustainable practices, these firms had increasingly longer years-of-existence (longevity).
H4A – Firms emphasizing interdisciplinary professional practice will have greater per capita revenue	**Inconclusive/Not supported** – The results of this test did not reveal any direction, pattern or curve, and therefore does not inform the research in one direction or another.
H4B – Firms emphasizing interdisciplinary professional practice will have greater continuity or longevity	**Inconclusive/Not supported** – Firms at one end of the interdisciplinary professional practice spectrum (single discipline) exhibited lower longevity, and firms with a high level of interdisciplinary practice appeared to have slightly longer firm life, but the difference was insignificant.
H4C – Firms seeking out and adopting new technologies will have greater pretax net profit performance	**Not supported** – In fact, firms that sought out and adopted new technologies actually endured lower pre-tax profits
H4D – Firms seeking out and adopting new technologies will have greater continuity and longevity	**Supported** – Firms that sought out and adopted new technologies appear to have greater longevity, with an average life of 33 years, versus firms that did not adopt new technologies, which resulted in an average life of 24 years.

"People want to be part of something larger than themselves. They want to be part of something they're really proud of, that they'll fight for, sacrifice for, that they trust."
__ Howard Schultz, Starbucks Corporation

"Knowledge is expensive, because the cost of ignorance is huge."
___ Oystein Fjeldstad, 1998

CHAPTER 8 QUALITATIVE ASSUMPTIONS, LIMITATIONS, SURVEY ANALYSIS

8.1 Qualitative Data Based on Current Theories of the Firm, Survey Questions, and Resulting Data and Evidence from Delphi Expert Panel

An overall aim of this research project is to establish an intersection between two firm-based conceptual models and to assess the resulting framework and its components based on expert knowledge. The two conceptual models, as discussed and diagrammed in previous chapters, consist of value logic process models developed in the US by Porter and in Scandinavia by Fjeldstad, and an asset factor input model specifically created for this research enquiry and validated by the expert panel during Phase II of the research methodology.

Architecture, engineering and construction (A/E/C) firms can be seen as complex adaptive systems, in which participants regularly adjust their roles and activities in order to respond to socio-economic disequilibrium (Pascale et al 2000). A number of studies of the construction industry have shown the significant impact of individual and collective human factors (e.g., organizational, competence and motivational assets) on firm performance (Soares and Anderson 1997; Pocock 1997). In an example of the findings of previous research, costs incurred by construction firms in the prosecution of their projects were found to be more significantly affected by the level of experience of the project team than any other factors (Soares and Anderson 1997). Because of the inadequacies of traditional scientific research in analyzing human systems, research of the design and construction industry also relies on qualitative methods of inquiry.

A number of studies in the field have been based on expert knowledge and views generated through surveys, expert panels and interviews to investigate issues and problems in the design and construction industry. The interpretive approach has been used both as a means of gathering and analyzing data, as well as a method for identification and conceptualization of research questions, which can subsequently be theorized and subject to further investigation (Seymour and Rooke 1995; Wing et al 1998). The goal of these enquiries is not only to extract and consolidate explicit knowledge, but also to elicit tacit knowledge that may be supportive of their "rules of thumb" (Palaneeswaran and Kumaraswamy 2003). The knowledge of an expert panel is regarded as a valid source of data because the individuals are members of an occupation, who through their skills in the application of instrumental rationality, have played a central role in creating technology and institutions [of their industry] (Seymour and Rooke 1995). However, because findings of a qualitative study exhibit more volatility and are challenged in the face of changing perceptions by experts and observers, the validity of the findings does not stem from repeatability of the results but instead from repeatability of the methodology used to produce the findings (Checkland 1999).

The following chart includes data requirements and variables for the qualitative portion of this tangibles/intangibles research.

Table 40 Data Requirements and Variables for the Qualitative Portion of this Tangible/Intangible Assets Research

- Asset Group Emphases – 7 Categories of Tangible and Intangible Assets
  1. Physical Natural
  2. Physical Produced
  3. Financial
  4. Legal and Registrable
  5. Organizational
  6. Competence
  7. Motivational

- Outcomes based on responses for sample firms A through F and identical sample firms G through L (two managerial strategic choices)
  - A. Firm Continuity and Longevity (Firms A – F)

B. Firm Short Term Profit Maximization (Firms G – L)

- Types of Sample Firms as Shown on Data Compilation Sheets
  A and G – Engineering Firm, 400 Employees, Infrastructure Projects
  B and H – EPC Firm, 4,000 Employees, Industrial Projects
  C and I – A/E Firm, 20 Employees, Institutional Buildings Projects
  D and J – Construction Firm, 200 Employees, Road Construction Projects
  E and K – Construction Firm, 20 Employees, Light Commercial Projects
  F and L – Design-Build Firm, 2,000 Employees, "Green" Sustainable Projects

- Delphi Expert Panel Respondent Categories – Five Professional Subgroups
  1. Engineers
  2. Architects
  3. Constructors
  4. Design-Builders
  5. Owners

- Value Logic Typology for Firms
  A. Value Chain
  B. Value Shop
  C. Value Network

8.2 Selected Hypotheses and Measurements:

H5A – Firms that operate as Value Shops, such as architectural and engineering firms, emphasize competence assets as factor inputs in their production cycles.

The hypothesis suggests that competence assets, such as experience, tacit knowledge, continuing development, group routines, corporate culture and other related factors, are of greater importance to value shop firms – such as architectural and engineering design firms – than other classes of assets. Competence assets are theorized to possess higher barriers to duplication, because of their relative valuableness, rarity, inimitability and non-substitutability (Barney 1991). Human resources assets are composed of education, training, incentives, adaptiveness and other attributes (Becker and Huselid 1998; Welbourne and Wright 1997). Corporate culture includes attitudes, values, trust, loyalty and related beliefs and behaviors held and shared within the firm, which guide its activities and decisions and distinguish it from other firms (Barney 1986; Welbourne and Wright 1997; Robbins 1998).

The hypothesis also incorporates individual and collective know-how into its range of intangible assets, which include tacit, causally ambiguous, complex and difficult-to-quantify attributes (Nelson and Winter 1982). Know-how is held and exercised by individuals, but also collectively by teams or entire firms (Crosson et al 1999). Included within the competence assets classification are internal and external relational capabilities, such as knowledge management and acquisition by firm employees and interactions with customers that build both alliances and knowledge pools (Hall 1992; Kogut 2002). For purposes of this research study, external relational assets are placed under Organizational Assets and Internal Relational resources under Competence Assets. This was done in order to increase granularity from which to view deployment of these sometimes overlapping capabilities.

Other research studies have examined product portfolios (outputs) and process portfolios (production processes), but very few have looked at factor portfolios (asset inputs). By creatively looking at factor input portfolios, firms can gain a different and richer perspective on items such as growth prospects and survival strategy (Galbreath 2004). Another shortcoming of existing research is the paucity of studies that have looked at the intersection between value logic process models and asset factor input models. It is at this nexus where the raison d'etre of a firm (i.e., its abilities to use factor inputs to produce goods or services more efficiently or more effectively than what could be found in the external market) is manifested to owners, investors, employees, customers and other stakeholders. And as instituted in this research, the factor inputs must be holistic, encompassing both tangible and intangible assets; or said another way, inclusive of both the corporeal asset base and the cumulative volitional asset base.

H5B – Firms that operate as Value Chains, such as traditional low bid construction companies, emphasize physical produced assets as factor inputs into their production cycles.

The value chain model is well-suited to companies that produce physical products, and in each market segment, these firms confront a cost or differentiation trade-off; which results in either lowering the scale of output to meet specific and targeted demand, or increasing scale to reduce cost per unit (Fjeldstad and Anderson 2003). Regardless of whether the production strategy chosen by firm management is scaled up or down, the hypothesis presumes that component flows and product mixes will flow through a mostly-sequential process, utilizing resources (factor inputs) that are heavily drawn more from physical asset stocks.

For a construction firm, the overall delivery of a project is largely concerned with transforming inputs into a functioning product. Cost is often a significant driver and the firm's management is frequently monitoring production rates and capacity utilization within a prescribed schedule. Disciples of Michael Porter would likely view the classic construction firm as a value chain. Value chain activities include inbound logistics, operations, outbound logistics, marketing, sales and servicing of products (Porter 1985). The value chain concept is not necessarily meant to mirror the steps of production, but is used to identify strategic improvement needs or opportunities for adding value at each major production step.

However, the assignation of the value chain designation to construction firms may be too simplistic or at least, partially inaccurate, for various subdesignations of contracting companies. For example, a piece-work subcontracting firm specializing in concrete foundations may have employees with specific skills applied excavation, formwork, reinforcing and placement of concrete for footings, grade-beams and other substructures using physical natural (extractive) and physical produced (manufactured) resources. But another construction firm may specialize in the coordination and construction of branch banking facilities, and employ seasoned project managers, but will subcontract almost all of the physical work to the skilled trades. Given the second firm's *services* orientation to its customers under this approach, would this construction firm not have more characteristics pointing toward value shop production, and therefore emphasis on organizational and competence assets?

As a precursor to questions about whether sample A/E/C firms focused on specific asset groups in the operation of their businesses, Delphi expert panel members were asked to designate the value logic (basic production modes) of the sample firms in the study. At the conclusion of the third round of questions, the experts gained consensus on four of the six sample firms, but were unable to agree on two of the firms; in fact, a handful of the panelists commented that the sample EPC (Engineer – Procure – Construct) and the sample design-build firms had both value chain and value shop characteristics.

A chart to show the asset category emphases (expert panel selections) for value chain organizations, value shop organizations and composite value chain + value shop organizations is shown below. The new rank order of asset emphases for A/E/C firms that combine both value shop and value chain characteristics – such as EPC and design firms – is competence assets (mean value score of 4.56), followed by organizational assets (4.30), motivational assets (4.15) and financial assets (4.02). By contrast, expert panelists gave value shop organizations only two asset categories with score higher than 4.0, including competence assets (with a mean value score of 4.57) and motivational assets (4.23). For value chain organizations, none of the asset categories garnered a score exceeding 4.00, although the tally for financial assets was close (with a mean value score of 3.96).

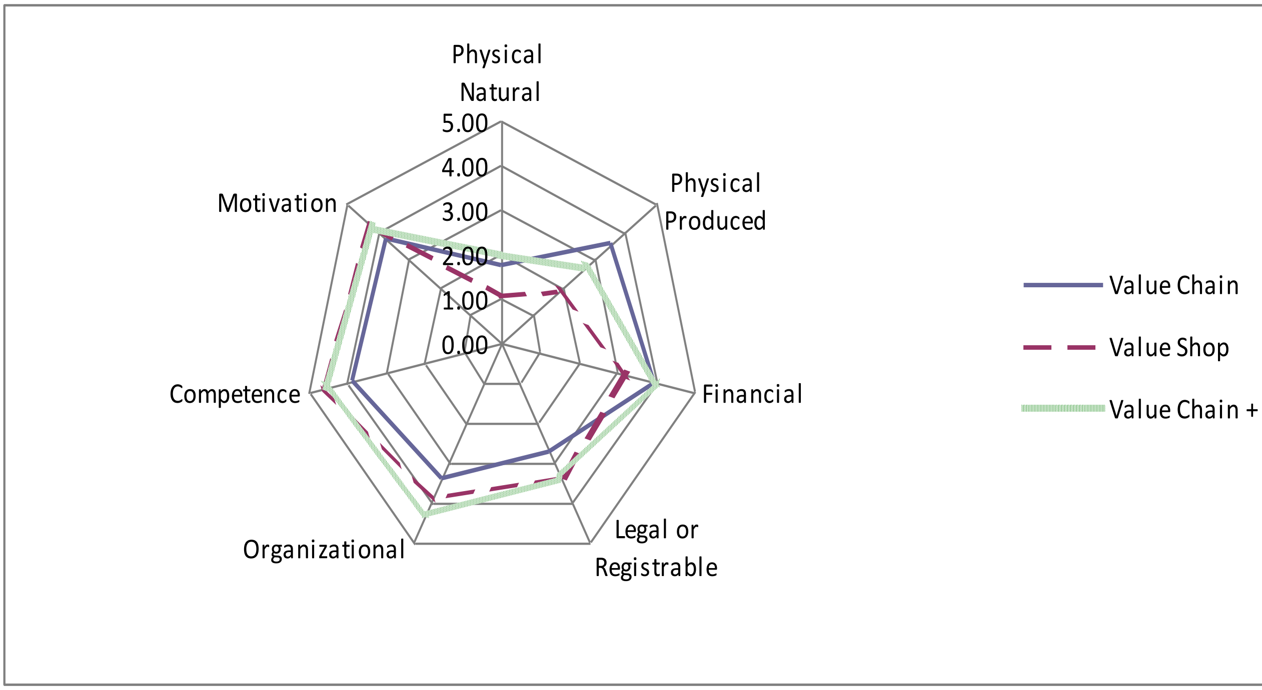


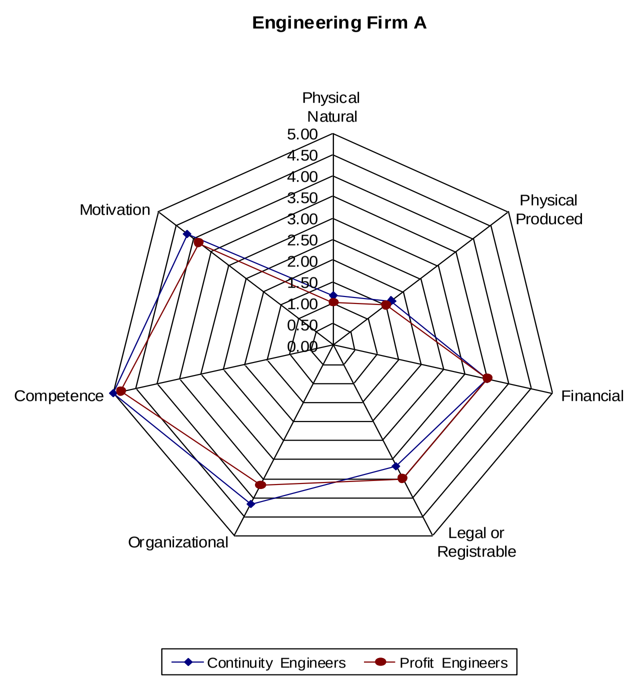
Figure 24 Overall Asset Emphases (Scored by Delphi Panel) for Value Chain, Value Shop and Value Chain + Value Shop A/E/C Sample Firms in Survey

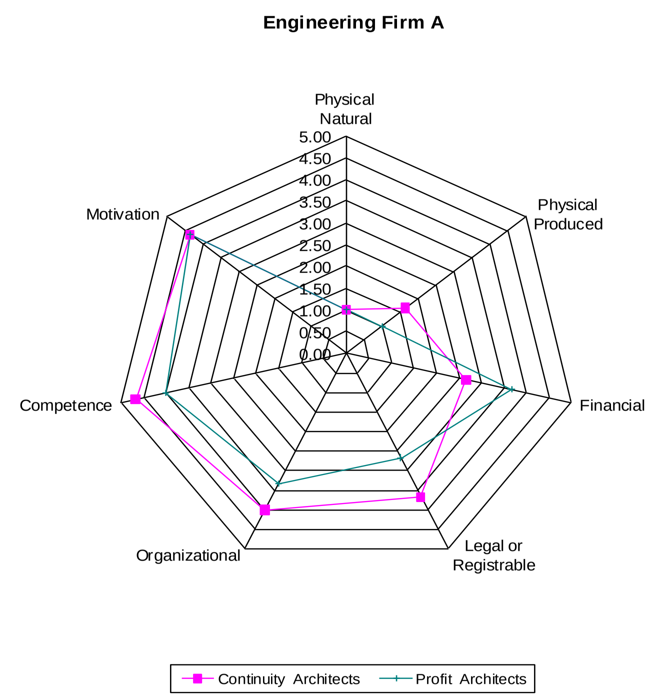
Together with a question soliciting information about the value logic (fundamental production processes) of sample firms, the Delphi expert panel was asked a series of questions to ascertain the asset deployment tendencies of the six A/E/C firms, given their operating market focus and employee base. The data was tabulated and analyzed by profession of the respondents, including architect, engineer, constructor, design-builder, owner and composite of all Delphi experts.

Further, the data was analyzed according to sample firm type and size, along with the seven asset categories covering the range of intangible and tangible resources that may be accumulated and deployed by firms. The analyses were summarized in various tables, charts and graphs for consideration of patterns or inconsistencies. The graphical method used primarily for research issues explored in this chapter was the radar chart (also known as the spider web chart or with dimensionality as star plots) as first developed by Georg van Mayr in 1877 (Friendly 2009). The radar chart is a useful graphical method for showing multivariate data using points on the spokes or radii, and connecting these with a corresponding plot line. The resulting web chart shows which variables are dominant for a given observation and what are similar among clusters of observations. This graphical method also reveals outliers and inliers that may need additional explanation.

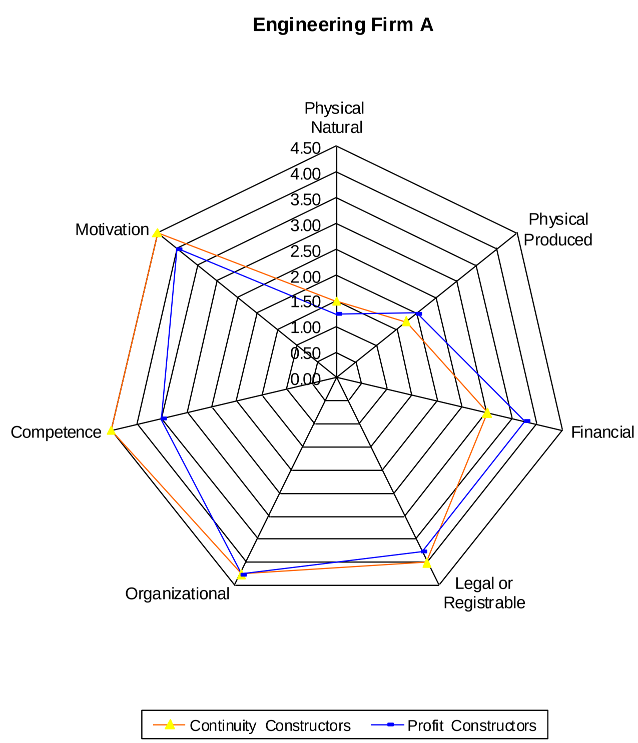
Figures 25.1 through 25.36 radar diagrams depict sample firm's emphases on 7 asset categories when management is focused on Continuity and Longevity versus Short Term Profit Maximization (according to the Delphi Expert Panel after three rounds to reach "consensus" (see pages 230 through

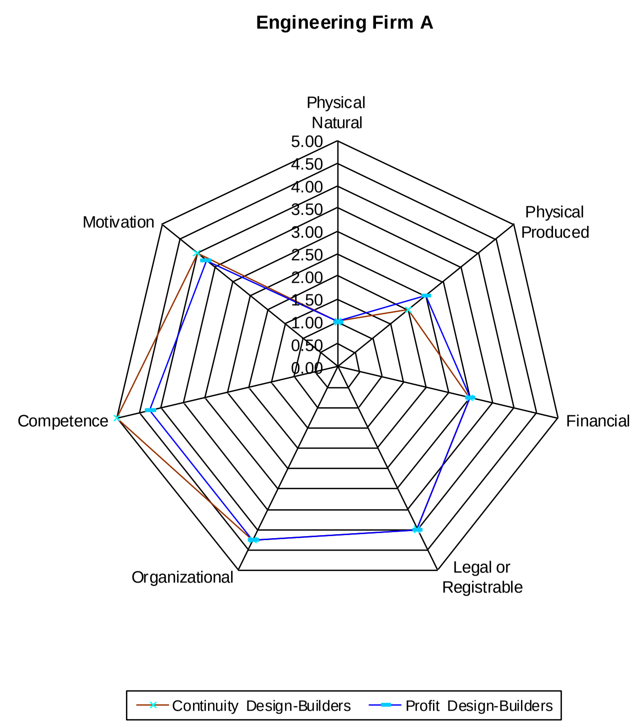
Engineering Firm of 400 Employees Concentrating on Infrastructure Projects –
Asset Category Emphases According to Expert Panel Engineers and Architects





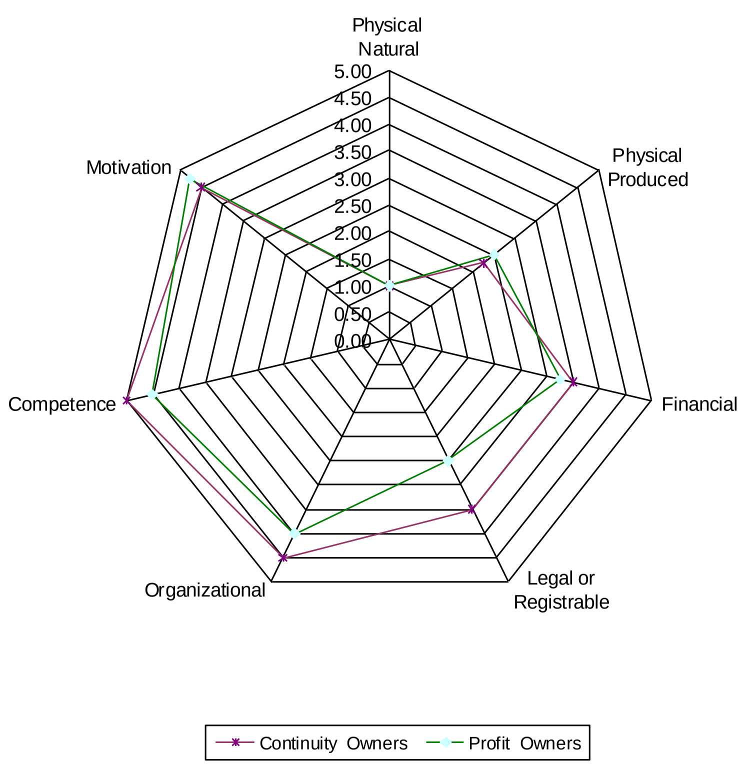
Engineering Firm of 400 Employees Concentrating on Infrastructure Projects – Asset Category Emphases According to Expert Panel Constructors and Design-Builders



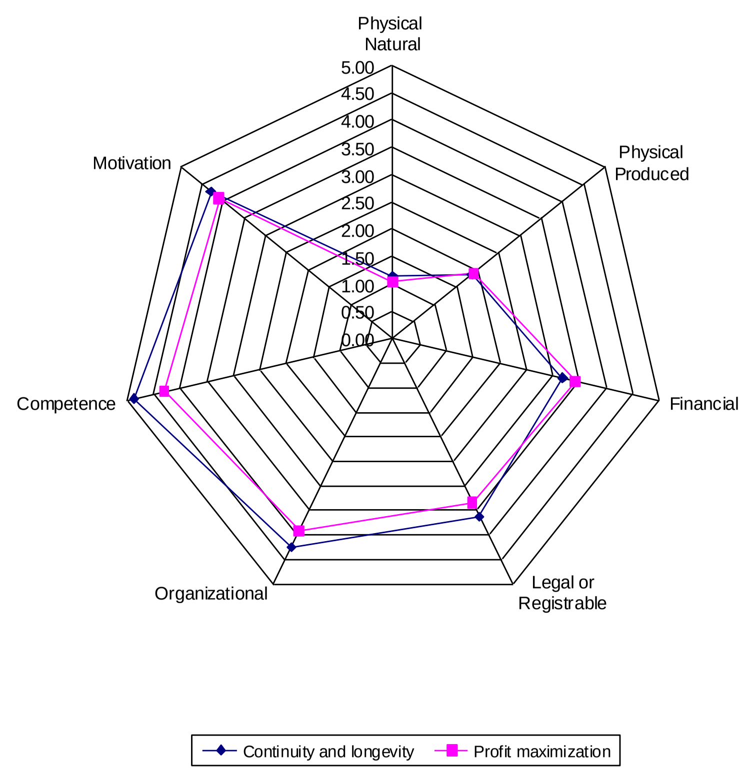


Engineering Firm of 400 Employees Concentrating on Infrastructure Projects –
Asset Category Emphases According to Expert Panel Owners and by Entire Delphi Group

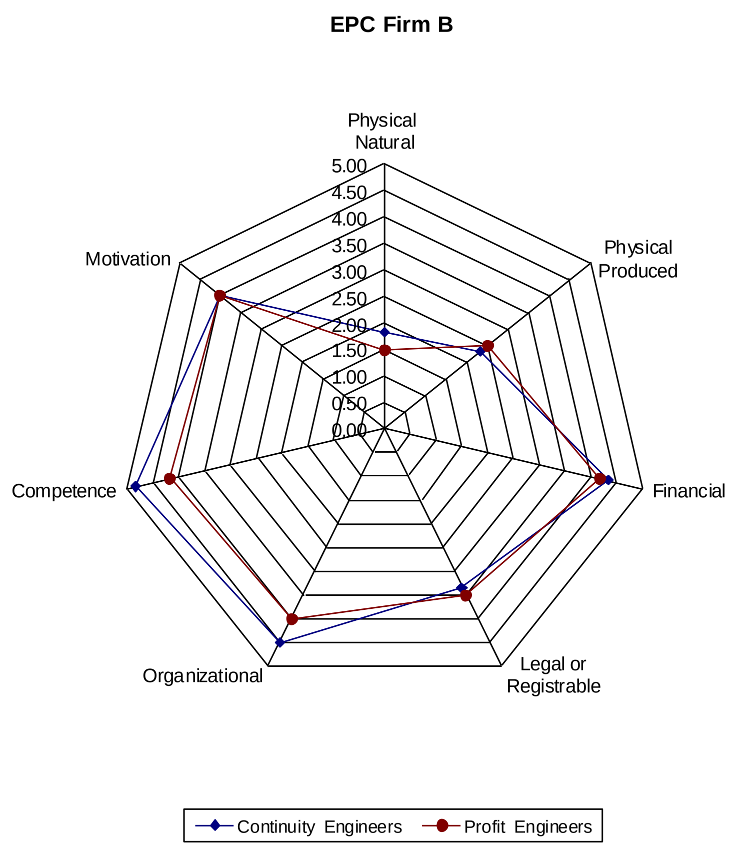
Engineering Firm A

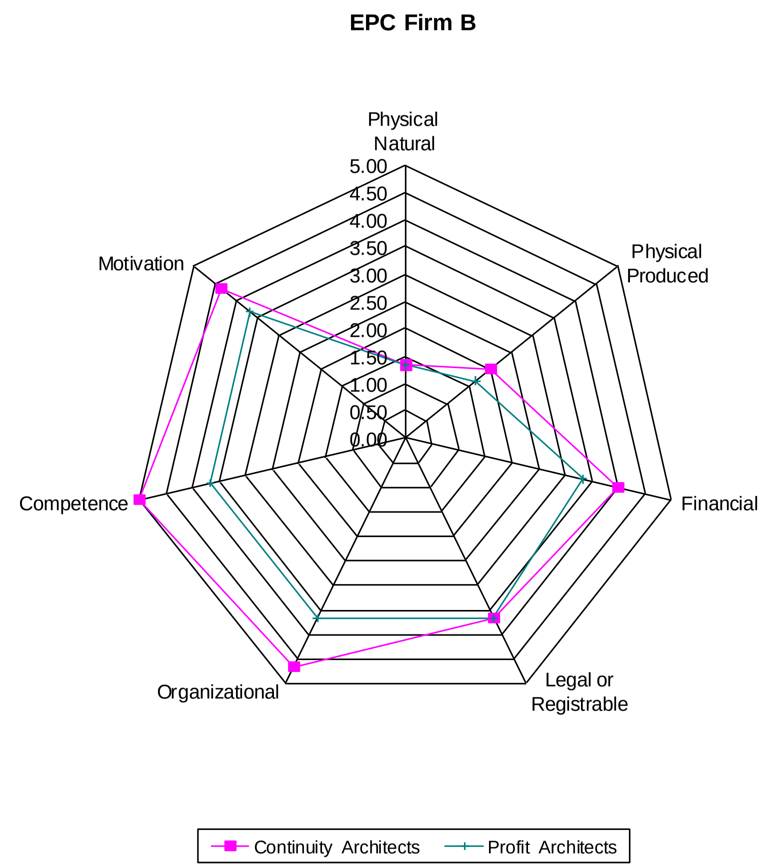


Composite Expert Panel Scoring for Engineering Firm A

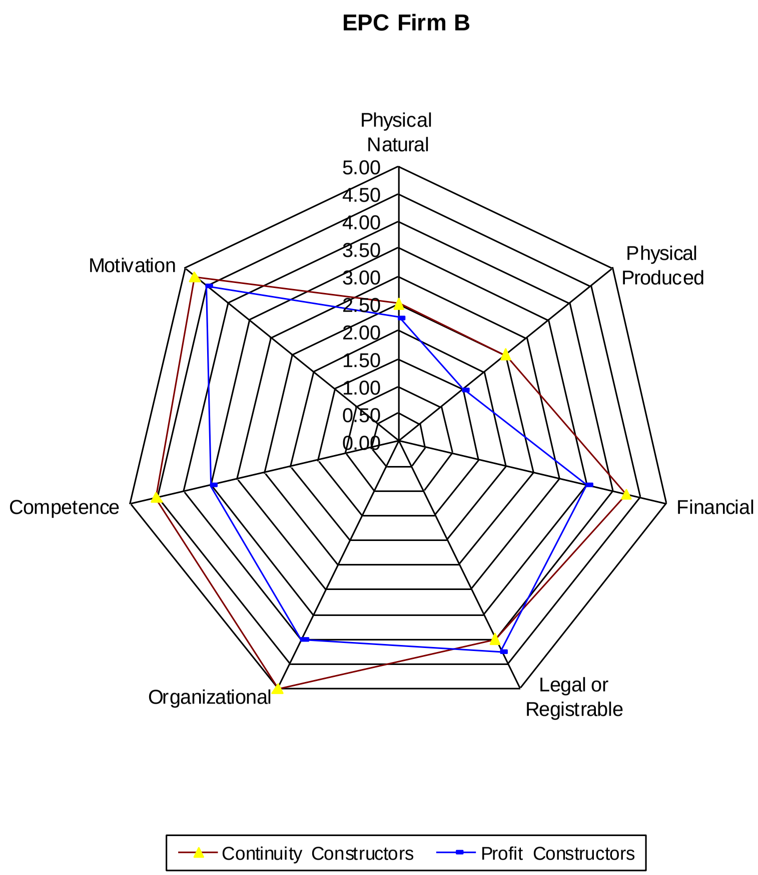


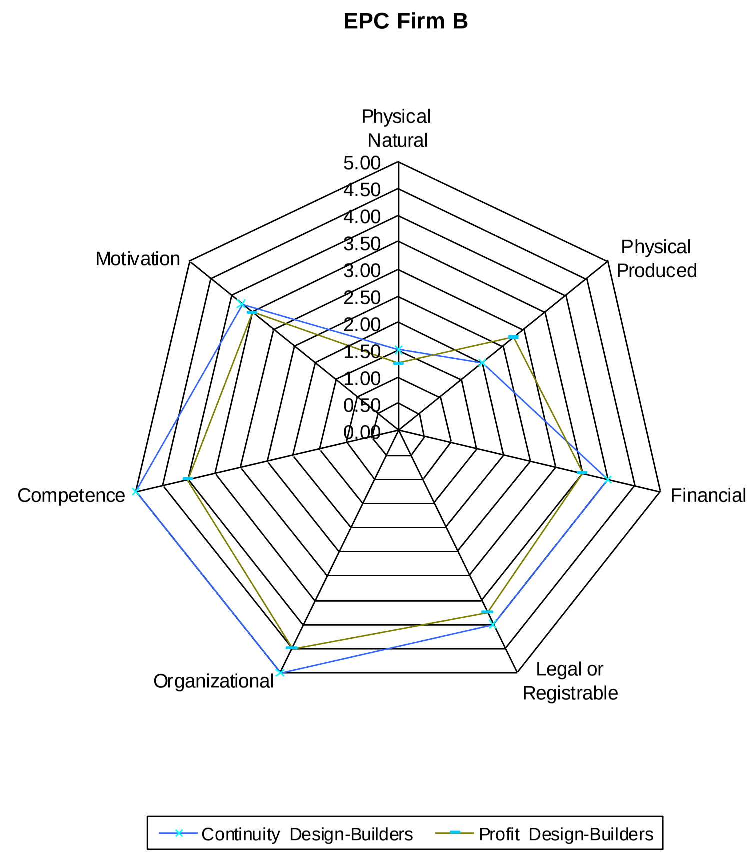
EPC Firm of 4000 Employees Concentrating on Industrial Projects –
Asset Category Emphases According to Expert Panel Engineers and Architects



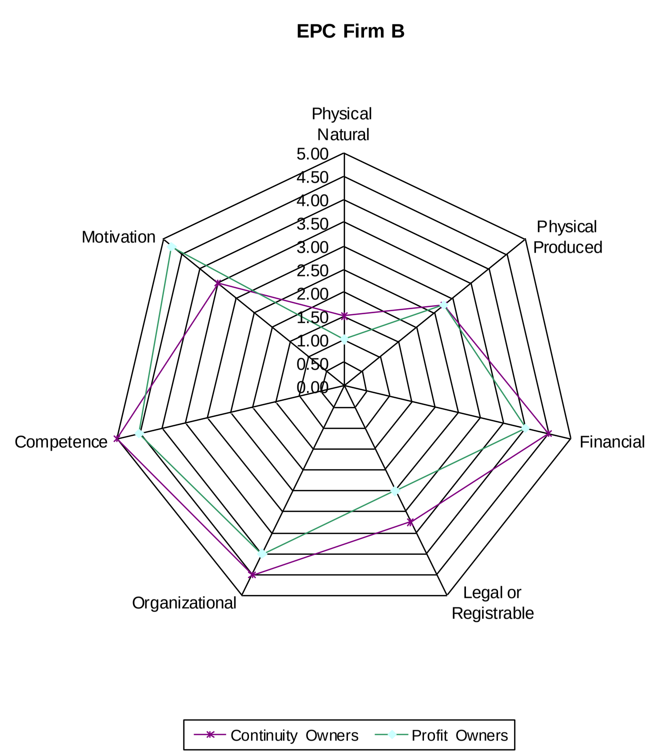


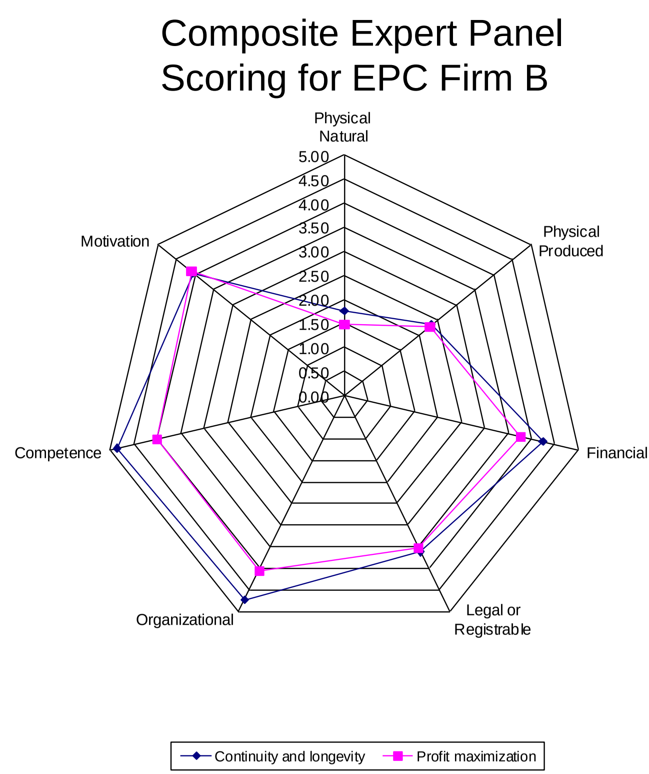
EPC Firm of 4000 Employees Concentrating on Industrial Projects –
Asset Category Emphases According to Expert Panel Constructors and Design-Builders



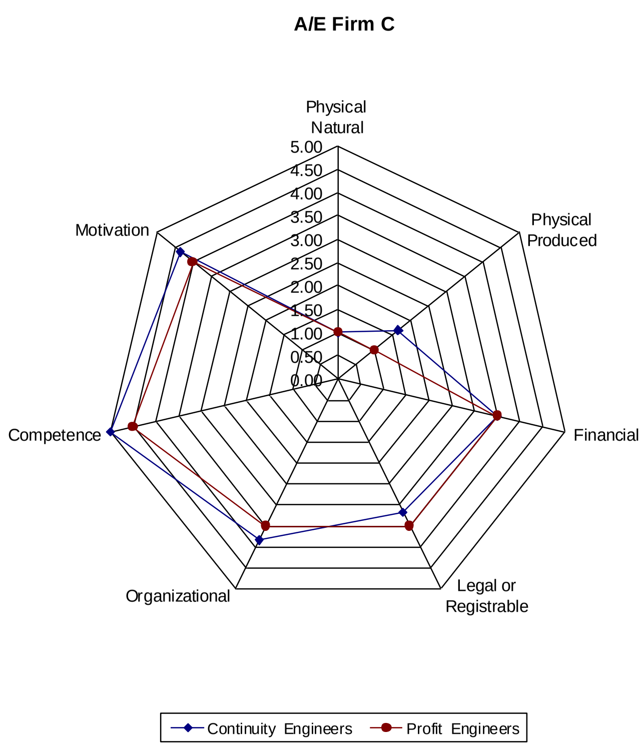


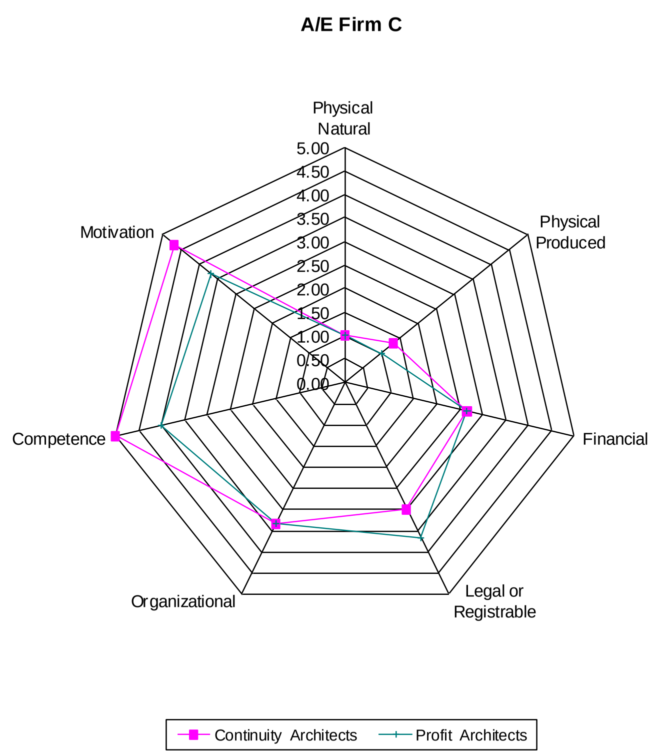
EPC Firm of 4000 Employees Concentrating on Industrial Projects –
Asset Category Emphases According to Expert Panel Owners and by Entire Delphi Panel



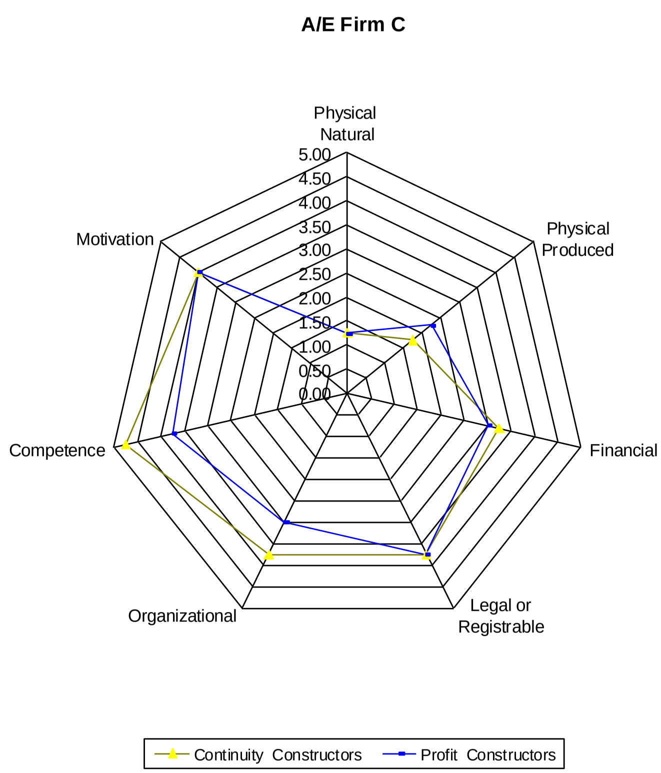


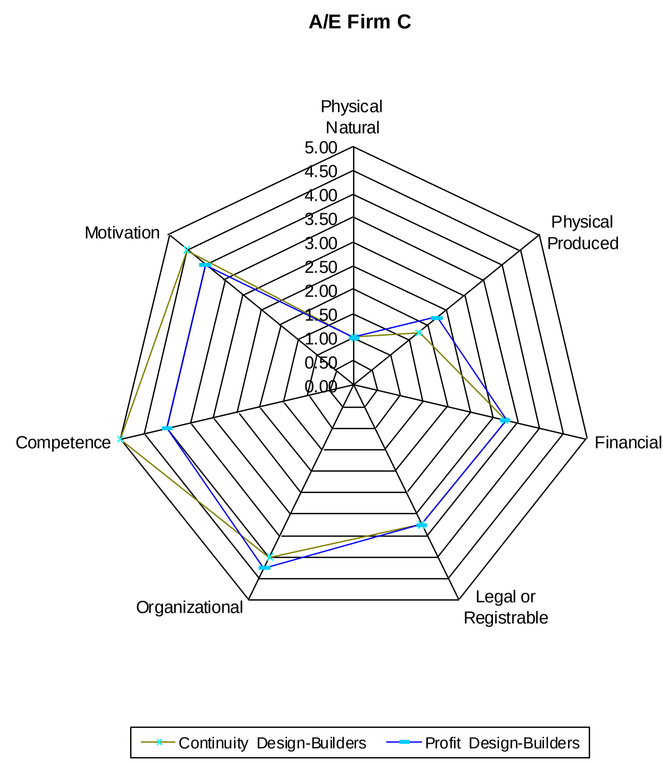
A/E Firm of 20 Employees Concentrating on Institutional Building Projects –
Asset Category Emphases According to Expert Panel Engineers and Architects



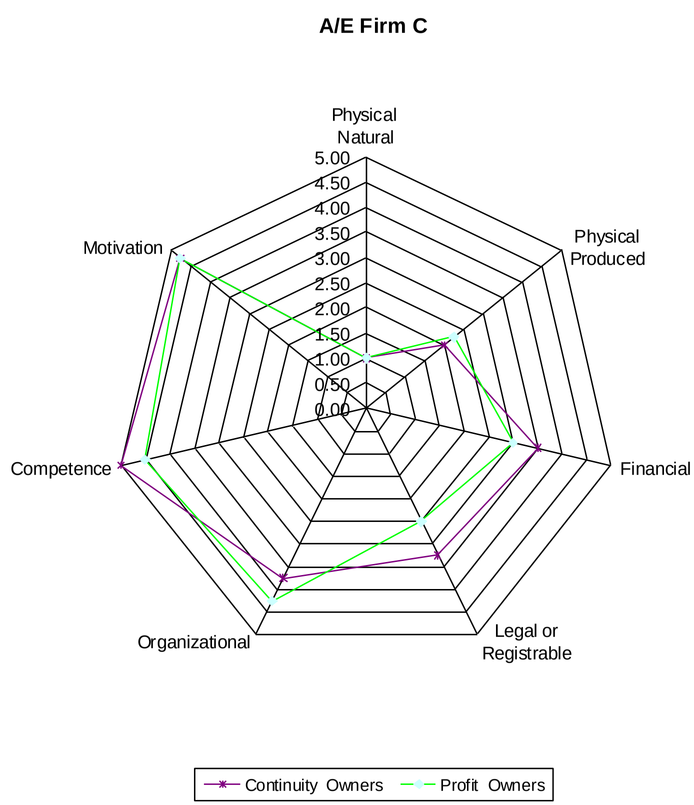


A/E Firm of 20 Employees Concentrating on Institutional Building Projects –
Asset Category Emphases According to Expert Panel Constructors and Design-Builders

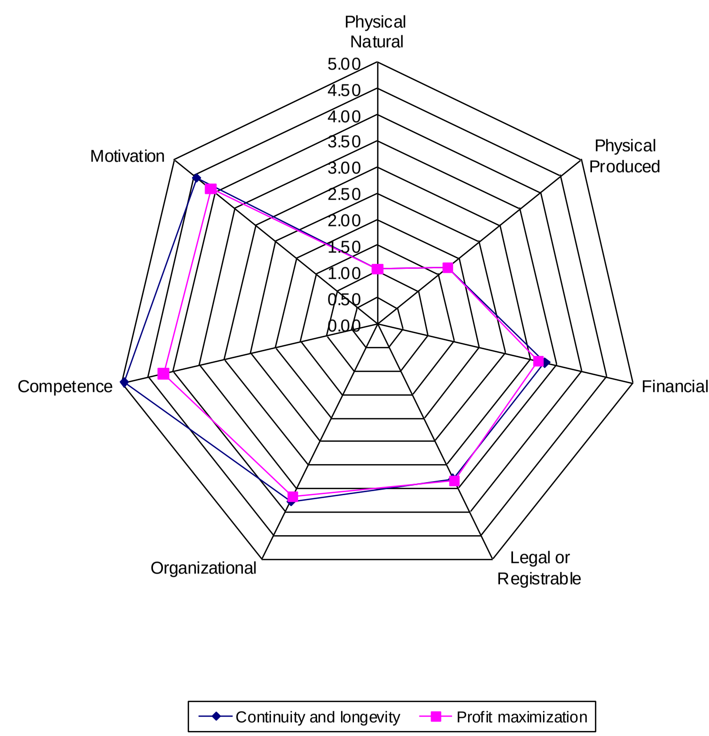




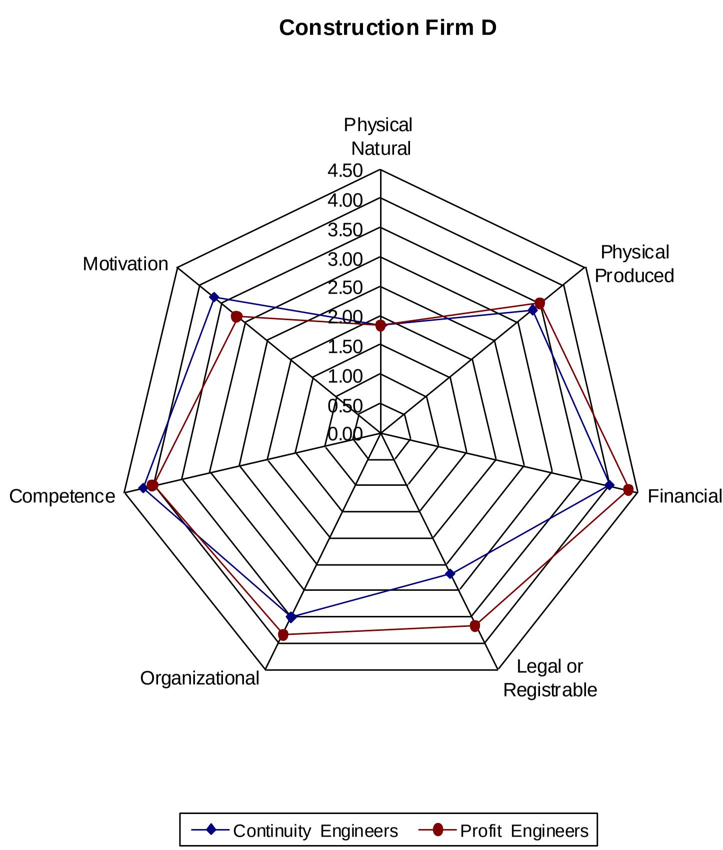
A/E Firm of 20 Employees Concentrating on Institutional Building Projects –
Asset Category Emphases According to Expert Panel Owners and by Entire Delphi Expert Panel

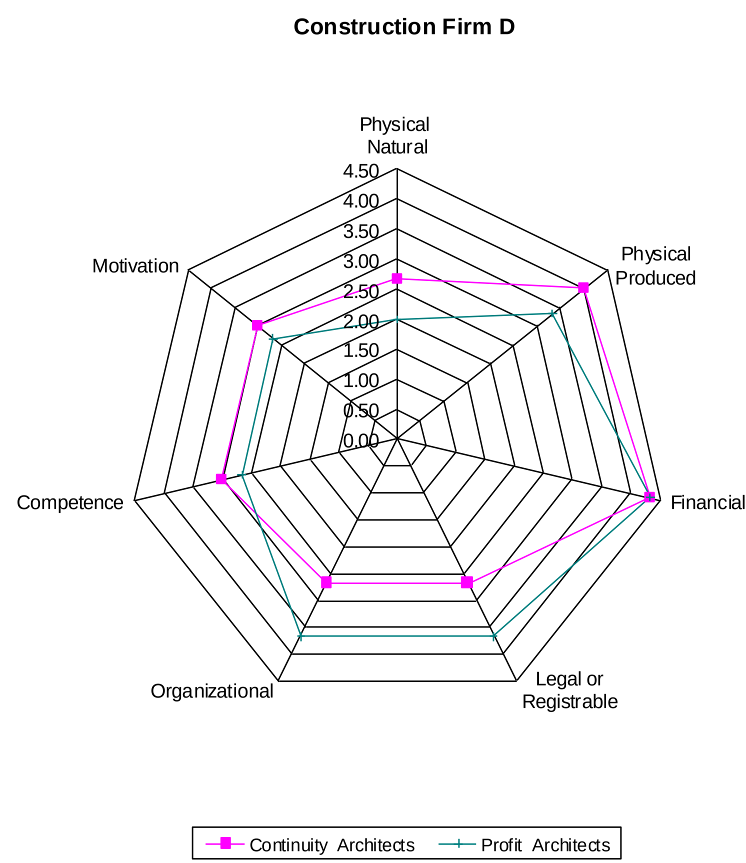


Composite Expert Panel Scoring for A/E Firm C



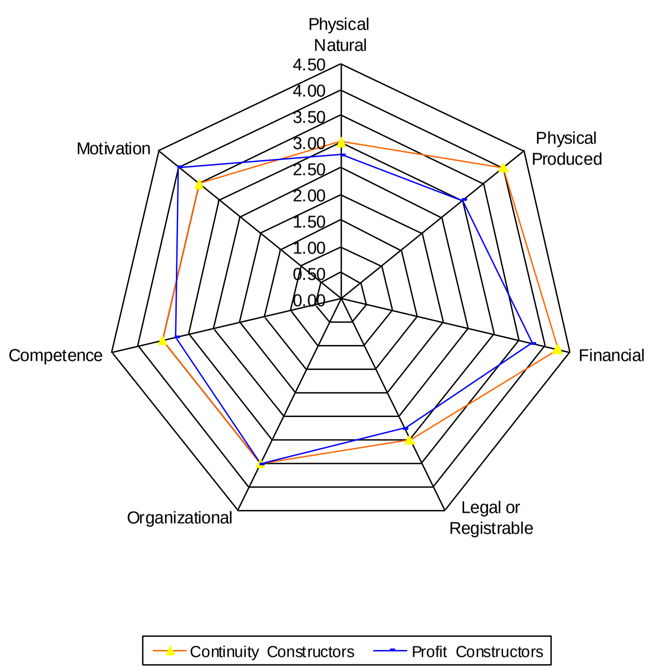
Construction Firm of 200 Employees Concentrating on Road Construction Projects –
Asset Category Emphases According to Expert Panel Engineers and Architects



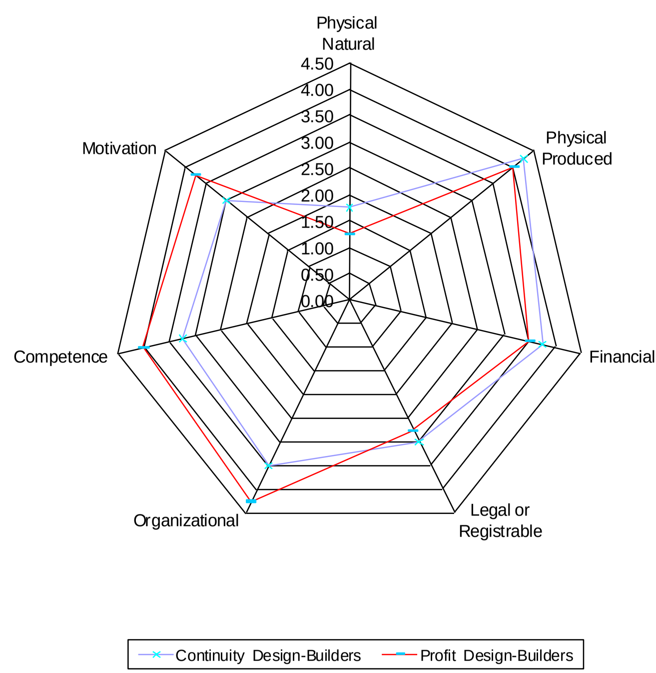


Construction Firm of 200 Employees Concentrating on Road Construction Projects –
Asset Category Emphases According to Expert Panel Constructors and Design-Builders

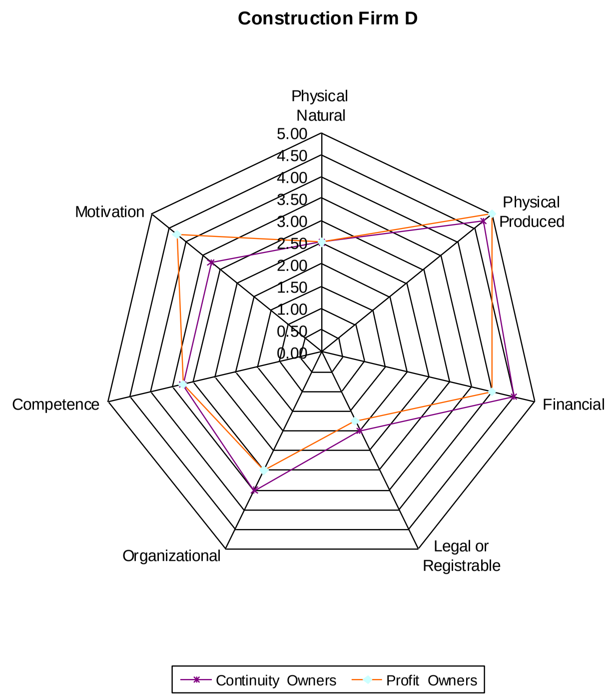
Construction Firm D

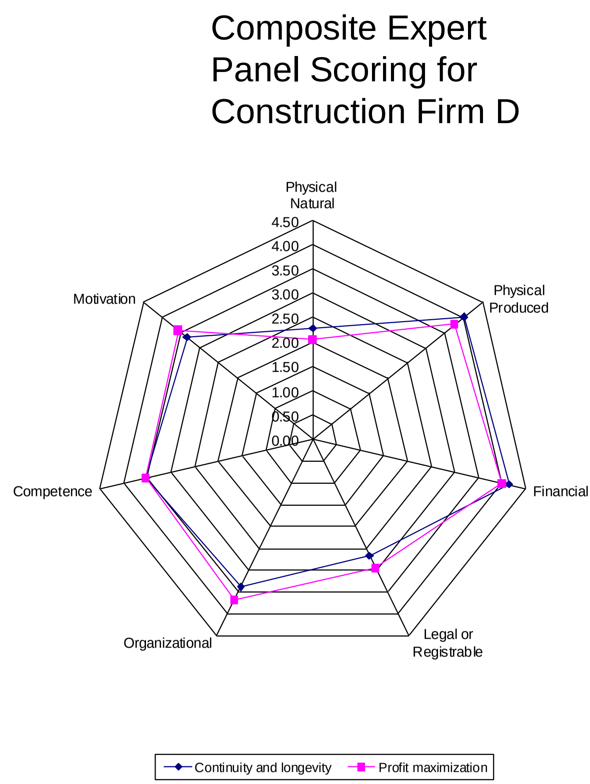


Construction Firm D

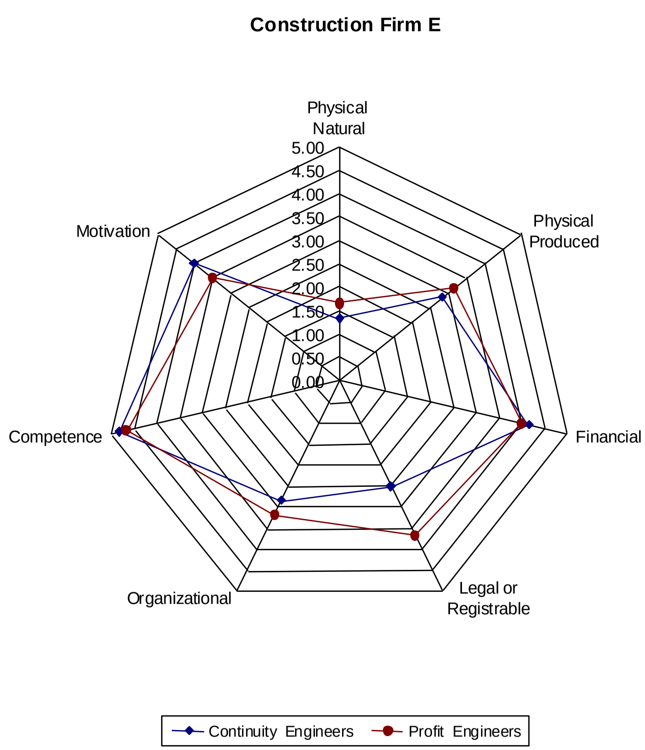


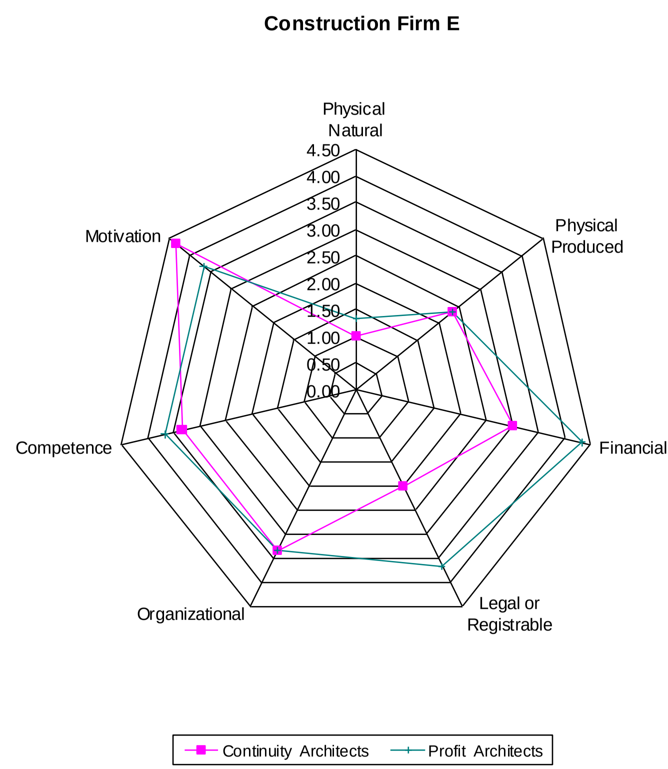
Construction Firm of 200 Employees Concentrating on Road Construction Projects – Asset Category Emphases According to Expert Panel Owners and by Entire Delphi Panel



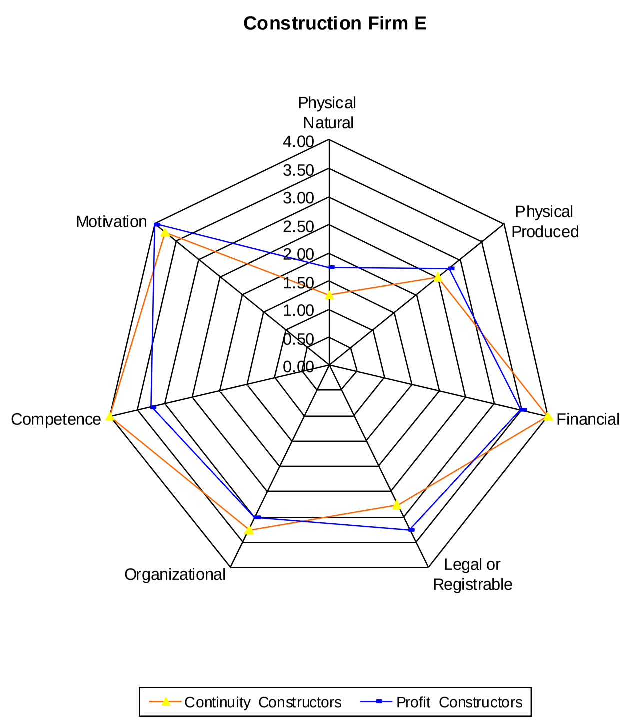


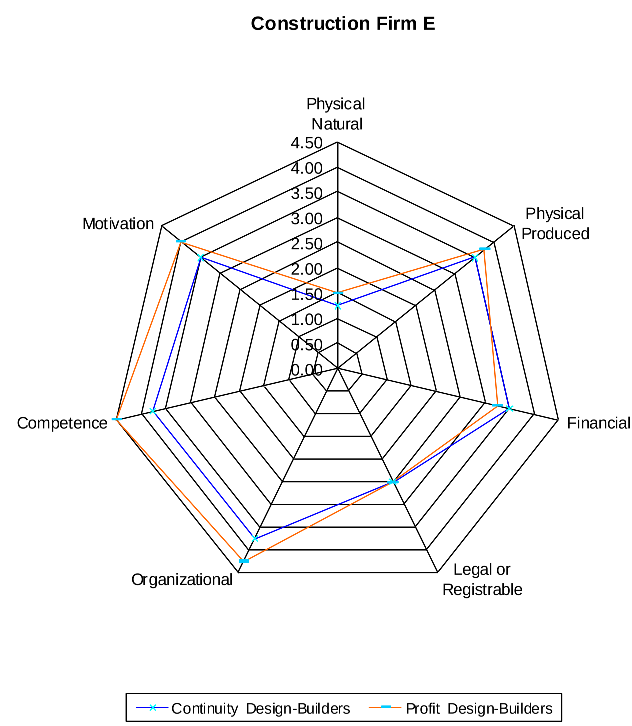
Construction Firm of 20 Employees Concentrating on Light Commercial Projects – Asset Category Emphases According to Expert Panel Engineers and Architects





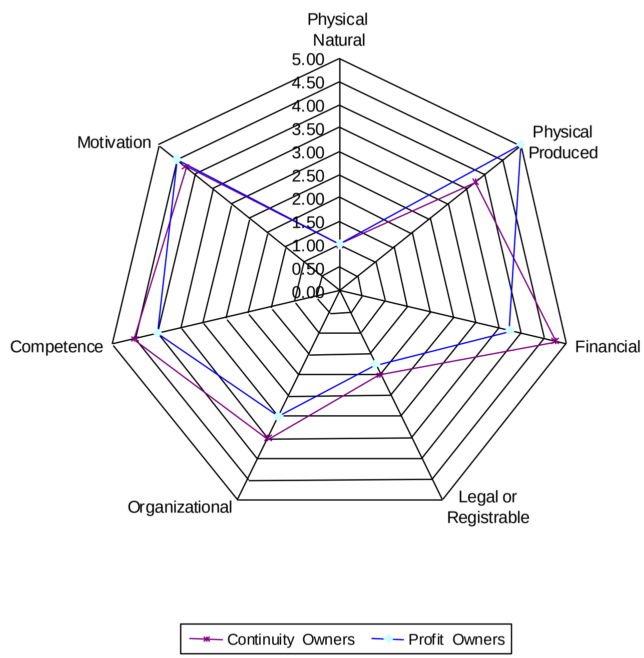
Construction Firm of 20 Employees Concentrating on Light Commercial Projects –
Asset Category Emphases According to Expert Panel Constructors and Design-Builders



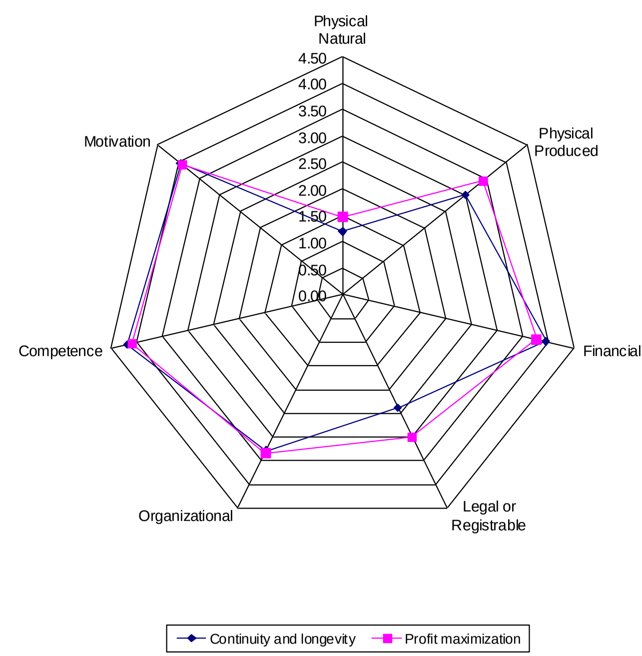


Construction Firm of 20 Employees Concentrating on Light Commercial Projects – Asset Category Emphases According to Expert Panel Owners and Entire Delphi Panel

Construction Firm E

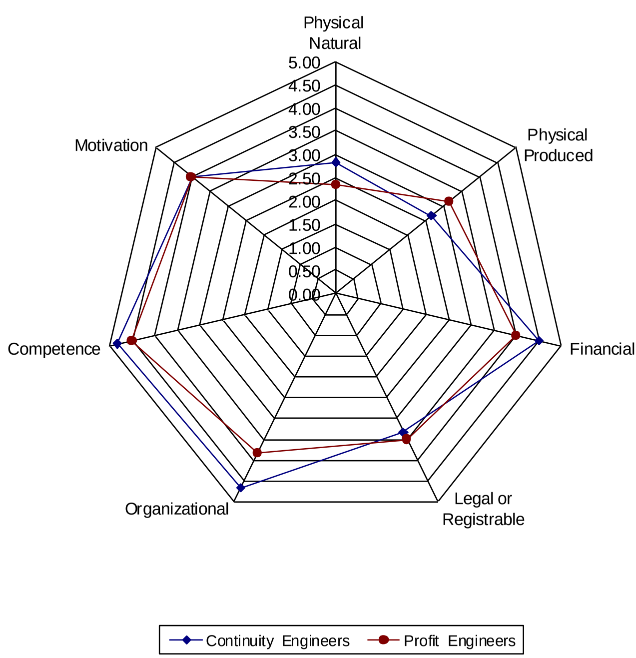


Composite Expert Panel Scoring for Construction Firm E

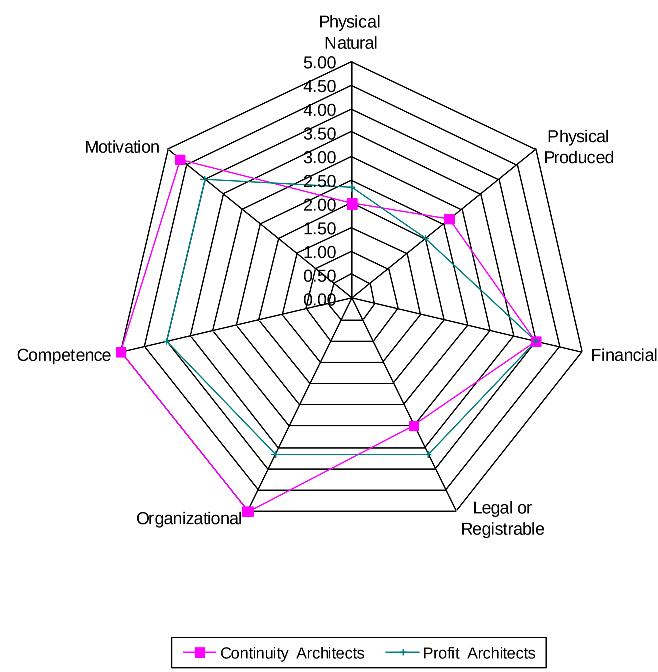


Design-Build Firm of 2000 Employees Concentrating on “Green” Sustainable Projects – Asset Category Emphases According to Expert Panel Engineers and Architects

Design-Build Firm F

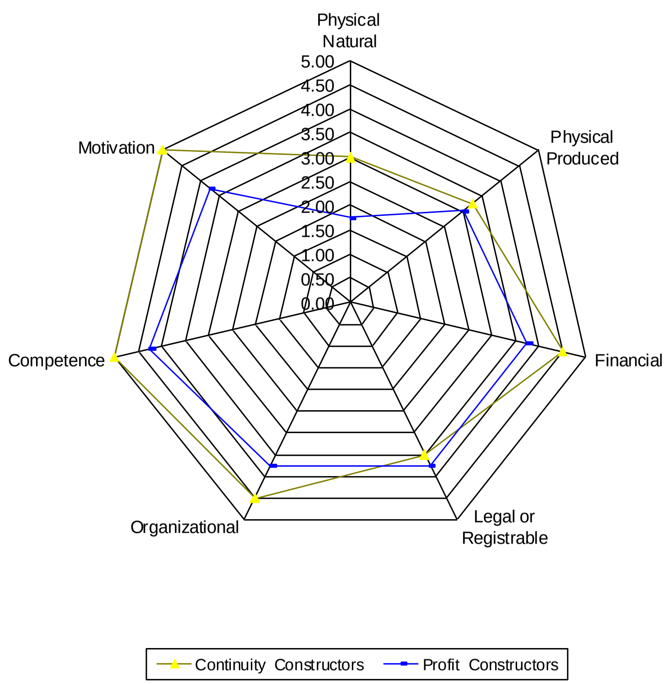


Design-Build Firm F

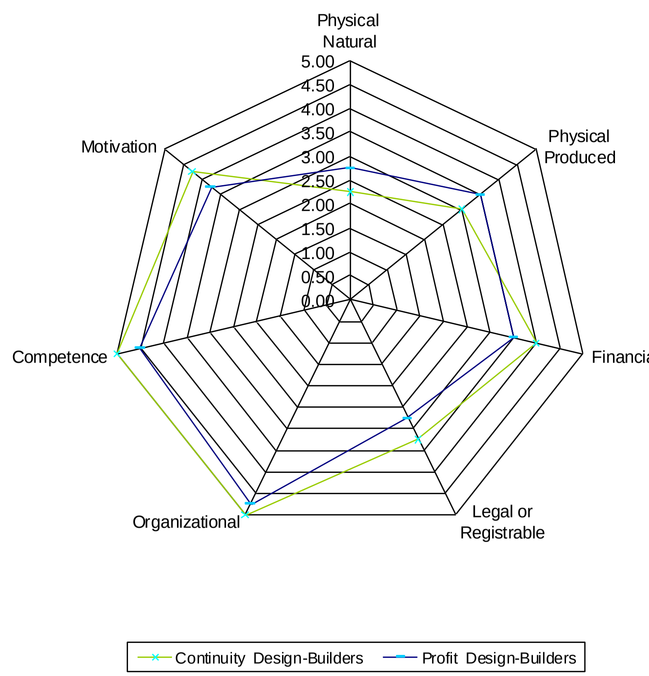


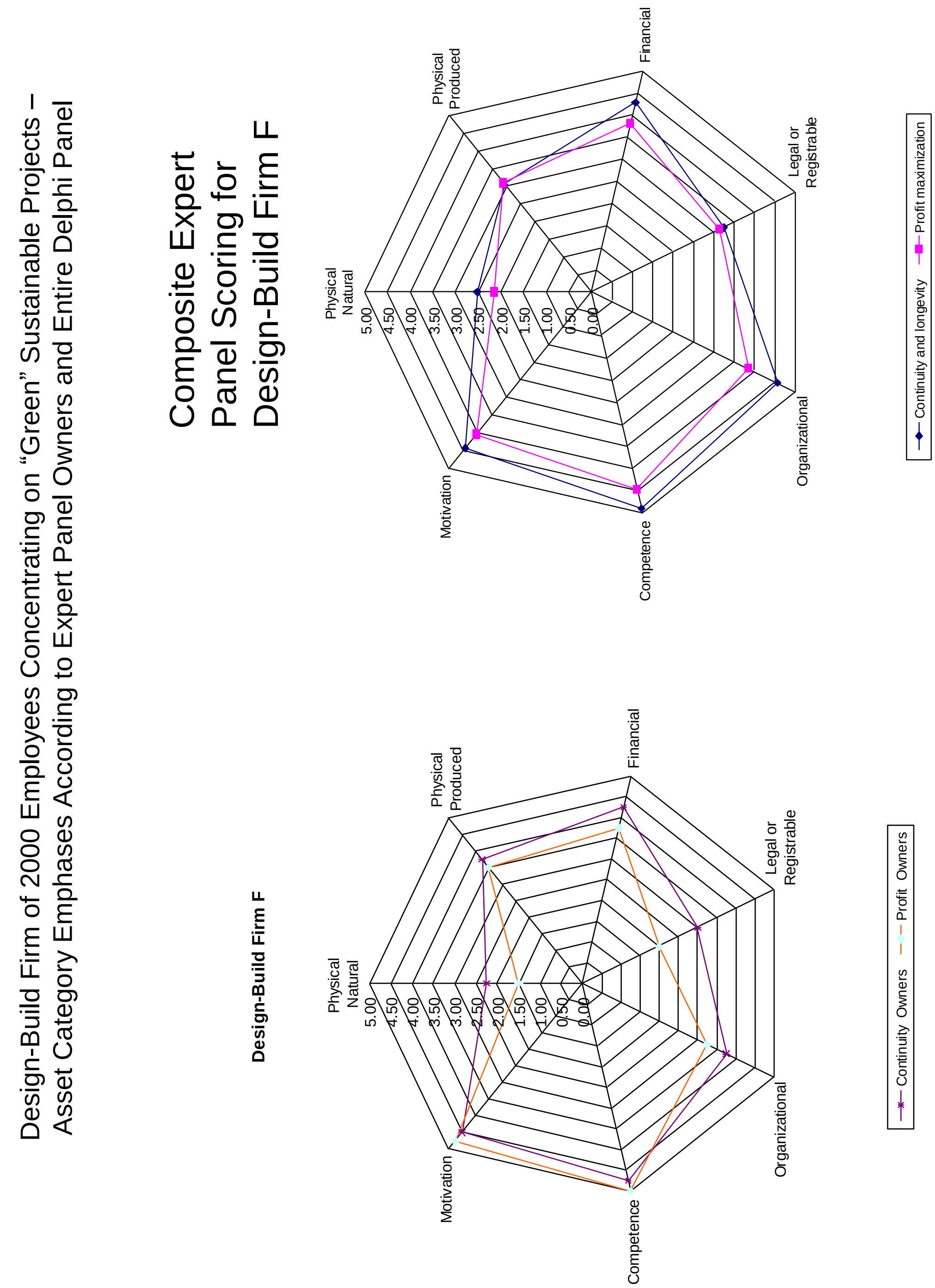
Design-Build Firm of 2000 Employees Concentrating on “Green” Sustainable Projects –
Asset Category Emphases According to Expert Panel Constructors and Design-Builders

Design-Build Firm F



Design-Build Firm F





Figures 25.1 through 25.36 Radar Diagrams Depicting Sample Firm's Emphases on 7 Asset Categories When Focused on Continuity and Longevity versus Short Term Profit Maximization

8.3 Delphi Method/Structured Feedback

The Delphi approach relies on expert judgments to arrive at the best information obtainable, which is similar to using a set of readings taken from an instrument that is subject to random error. A statistical measure of central tendency allows the researcher to arrive at a quantity, with some measure of dispersion noted as a confidence interval about the central value (Dalkey 1969). In this research project, a structured Delphi process is employed for the purpose of gaining consensus from experts on questions for which there has been very little empirical research. In an essay entitled *Normative System Building*, Sutherland claims that complex systems require a meta-hypothesis, with elements linked together in a consistent system of concepts to form a simplified model that can serve as a surrogate for analysis; and he suggests that the Delphi hypothesis – experimentation – feedback process is a reasonably well-controlled experiment (Sutherland 2002).

Delphi panels generally range in size from 5 to 100 persons, but most have incorporated 10 to 35 participants (Gordon 1994). In Phase II of this research project, the Delphi panel at the outset consisted of 24 persons, each with at least 20 years of management experience in the industry. Due to time constraints and other factors, by the end of the third round, 21 persons completed the survey and 3 persons not to participate in the panel. Most of the change in panelists' responses occurs after one or two iterations (Rowe and Wright 1999). Because of increasing demands for time brought on by successive later rounds, there is a higher incidence of withdrawal from participation if there are multiple numbers of rounds (McKenna 1994). Consensus may be maximized with two or three rounds, with most of the consensus achieved in the second round and incremental additional quality in responses gained in the third round (Woudenberg 1991). Based on these recommendations, this research project used a structured Delphi approach with three rounds of questionnaires with feedback data provided by the researcher to all expert panelists after Delphi rounds one and two.

In order to arrive at an acceptable level of consistency in the responses, a statistical test relying on calculations of Kendall's coefficient of concordance (*W*) was employed. Kendall's W can be interpreted as a coefficient of agreement among respondents, ranging from 0 to 1, with 0 indicating complete disagreement among respondents and 1 signifying complete agreement among respondents (Chan et al 2001). The W values and their significance is provided in Table XXX in the Appendix. Results show that there is some agreement on specific tangible and intangible asset classifications but not on other asset groupings. In addition, the results show partial agreement on two value logic typologies, with virtually no agreement on a third value logic typology (value network). However, for certain types of hypothetical firms, if two value logic types are combined into a composite (value shop plus value chain), there is a significantly higher degree of agreement for firms that were judged to have attributes of both logic types by the Delphi expert panel members.

8.4 Asset Selection/Deployment by Firms Based on Expert Judgments – Findings

To address the fundamental research questions, a methodology for studying resources developed by Fahy and Galbreath was adapted and further refined (Fahy 2002, Galbreath 2004). Resources in the form of tangible and intangible assets were operationalized across seven constructs: physical natural, physical produced, financial, legal and registrable, organizational, competence and motivational. The hypotheses indicate what asset classifications are more important given specific types of A/E/C firms, with the asset choices linked to the firm's long-term continuity (multi-year business survival) or short-term financial success (profit maximization over the next quarter).

Table 41 Hypotheses and Findings-In-Brief for Qualitative Portion of the Research

HYPOTHESES	**FINDINGS - IN - BRIEF**
H5A – Firms that operate as value shops, such as architectural and engineering firms, emphasize competence assets as factor inputs into their production cycles.	**Supported** – for **engineering firm** of 400 employees concentrating on infrastructure projects regardless of whether management emphasis is upon continuity and longevity of the firm, or upon short term profit maximization.
H5A	**Supported** – for **architectural firm** of 20 employees concentrating on institutional building projects, regardless of whether management emphasis is upon continuity and longevity, or upon profit maximization.
H5A	**Partially Supported** – for **EPC firm** of 4,000 employees concentrating on industrial projects. Managerial emphasis is highest on competence assets for continuity and longevity; however, if the emphasis changes to profit maximization, financial assets are emphasized.
H5A	**Supported** – for **design-build firm** of 2,000 employees concentrating on green infrastructure projects, regardless of whether management emphasis is upon continuity and longevity, or upon profit maximization.
H5B – Firms that operate as value chains, such as traditional low bid construction companies, emphasize physical produced assets as factor inputs into their production cycles.	**Partially supported** – for **construction firm** of 200 employees concentrating on road-building projects. Panelists scored financial assets highest (most emphasized), physical produced assets second and organizational assets third when management emphasis was on continuity and longevity, & scored the same rank order when management emphasis was profit maximiz.
H5B	**Not supported** – for **construction firm** of 20 employees concentrating on light commercial projects, panelists scored competence assets highest, motivation assets second and financial assets third when asked which asset classes were emphasized when focused on continuity and longevity, and when focused on profit maximization.
H5B	**Not supported** – for **EPC firm** of 4,000 employees concentrating on industrial projects. When asked about the firm's focus on continuity and longevity, panelists said that the firm would emphasize competence assets first, organizational assets second and financial assets third. If the focus was profit maximization, the panelists placed motivation assets first, organizational second and competence third.
H5B	**Not supported** – for **design-build firm** of 2,000 employees concentrating on green sustainable projects. When asked about the firm's focus on continuity and longevity, panelists scored competence assets first, organizational assets second and motivation assets third. With focus on profit maximization, panelists scored competence assets first, motivation assets second and organizational assets third. For either managerial focus, panelists listed financial assets as the fourth (of seven) most important assets classes.

Hypothesis H5A suggests that firms that operate as value shops -- defined as entities that solve previously unsolved problems for customers through iterative applications of expertise and skill – would emphasize competence assets as inputs into their production cycles. The findings show that this expectation is generally borne out; however, when a firm is not a "pure" value shop as in the case of an EPC firm (which also has value chain activities), then the emphasis shifts to financial assets where profit maximization is the chosen managerial goal, according to the Delphi panel.

An engineering firm of 400 employees and an architectural firm of 20 employees were the two "pure" value shop sample firms considered by the Delphi group. When focused on *continuity and longevity*, the engineering firm (according to the experts surveyed in this study) emphasized competence assets at a mean value of 4.86 (scale of 1 to 5), however the subset of constructors on the panel scored the competence at a low of 4.50. When the engineering firm is focused on *profit maximization*, the experts ranked competence assets as most emphasized (among the seven categories) at 4.29; however, the subset of construction experts on the panel gave this only a 3.50 rating, and instead scored organizational assets as the most emphasized, with a mean value of 4.25. Similarly, the architects on the expert panel ranked the engineering firm focused on profit maximization as emphasizing competence assets, but only at a mean value of 4.00. Engineers on the expert panel scored the sample firm's competence assets at the highest levels, with a mean value of 5.00 when focused on continuity and longevity and a mean value of 4.83 when focused on profit maximization.

The architectural firm of 20 employees received a mean value score of 4.95 for competence assets when the firm is concentrating on continuity and longevity, and a mean value score of 4.19 when the firm is focused on profit maximization. While still listing competence assets as the most emphasized class of factor inputs for the architectural firm when the firm is focused on continuity and longevity, constructors on the expert panel gave the level of competence assets a mean value of 4.75, and when the small architectural firm is focused on profit maximization, construction experts placed motivational assets as the most emphasized at a mean value of 4.00, with competence and legal/registrable assets tied for second most emphasized at a mean value of 3.75. Similarly, owners on the expert panel scored the architectural firm's motivational assets highest (at 4.75) when profit maximization is the architectural firm's managerial focus.

To more fully explore how firms within the A/E/C industry can be measured against the value logic theory of Stabell and Fjeldstad, it is realistic to include firms that have value shop capabilities within their operating structures as part of this study, although these firms also have characteristics typically found in value chain organizations. Engineer-Procure-Construct (EPC) firms and design-build firms provide or furnish A/E design, and although these professional services may only be ten to fifteen percent of their annual receipts, the embeddedness of these capabilities differentiates these firms within the marketplace. Therefore, the sample EPC and design-build firms listed in the Delphi survey series are included as part of the testing of Hypothesis H5A.

Of the seven factor input asset categories, expert panelists scored competence assets as the most important class of assets (score of 4.86) for the sample EPC firm of 4,000 employees when management emphasis is upon continuity and longevity, and with organizational assets a close second at a mean value score of 4.71. When management concentrates upon profit maximization instead, the asset class achieving the highest composite score was motivational assets, at 4.10, followed by organizational assets at 4.05 and competence assets at 4.00. Similarly, the sample design-build firm of 2,000 employees (when management focused on continuity and longevity) received highest scores for competence assets with a mean value of 4.90, followed by organizational assets at 4.57 and motivational assets at 4.43. When concentrating on profit maximization, the most emphasized asset class for the sample design-build firm was competence at 4.48, followed by motivation assets with a mean value of 4.05.

A separate question in the Delphi questionnaire series asked respondents to list individual assets that may be emphasized by each of the sample firms. Reliance on specific asset categories scored above is compared to the asset categories that the individual asset selections represent at the end of this section of Chapter 8.

Hypothesis H5B suggests that firms operating as value chains – defined as entities that use standardized processes and repetition of tasks to produce objects, materials, equipment or assemblies – emphasize physical produced assets as factor inputs into their production cycles. The findings of the survey research do not generally support this supposition. Instead, the value chain companies within the design and construction sector rely more heavily on financial assets if the firm is engaged in a market sector where the work is seen as a commodity and low bid procurement is prevalent, and if the construction firm is engaged in custom light commercial projects (presumably, most of this work would be private sector construction), competence assets were emphasized over the other six asset classes.

Specifically, expert panelists were asked to rank the most important class of factor inputs deployed by the sample construction of 200 employees concentrating on road construction projects. For this given firm, the Delphi group ranked financial assets as the most emphasized for purposes of continuity and longevity (at a mean value of 4.14 on a scale of 1 to 5), with physical produced assets second (at 4.00). The panelists reaffirmed the asset mix again in accordance with the firm's emphasis on profit maximization, ranking financial assets at a mean value of 4.00, physical produced assets at 3.76 and organizational assets at 3.67. In particular, the Delphi subset of Owner experts ranked financial assets as the most important class with scores of 4.75 for continuity and longevity of the firm and 5.00 for profit maximization purposes.

However, the emphasis on financial assets was not as pronounced for the sample light commercial construction firm of 20 employees. For this small firm working with (presumably) private clients, competence assets were ranked as most important (mean value of 4.19), followed by a tie between financial and motivation assets (both at 3.95). Similarly, the most emphasized asset classes remained in rank order when the panelists were asked to consider profit maximization of the firm: competence was scored at a mean value of 4.10, motivational at 3.90 and financial at 3.76. Interestingly, professional constructors on the expert panel ranked financial and competence assets highest at a mean value of 4.00 for both classes when asked about the sample firm's *continuity and longevity*. And when asked about the firm's *profit maximization*, the Delphi panels architects and engineers both listed financial assets (at 4.33 and 4.00 respectively) highest, whereas the constructors on the expert panel scored financial assets at a relatively midrange 3.50.

Consistent with the approach taken with the previous hypothesis, EPC and design-build firms are rated in this section and scores are compared with the two "pure" value chain construction companies. As stated earlier, because an EPC or design-build firm signs contracts and prosecutes a project as a legal entity representing both the designer-of-record and the constructor-of-record, the business operating level, these firms are performing as both value chain and value shop enterprises, which represents more-or-less a composite of two value logic approaches and appears to be the exception rather than the rule in most market sectors.

The sample EPC firm of 4,000 employees concentrating on industrial projects was viewed by the Delphi panel as emphasizing competence assets (with a mean value score of 4.86) when the managerial goals were continuity and longevity, followed in second place by organizational assets (at 4.71). On the other hand, when the firm strategy centered on profit maximization over the short term, the expert panelists said the firm would emphasize motivational assets first (at 4.10), followed by organizational assets (at 4.05) and competence assets (at 4.00). Design-builders and owners tended to score the emphasis on organizational and competence assets high for EPC firms, with design-builders listing 4.0 for organization and 5.0 for competence when continuity and longevity is being emphasized, and owners scoring 4.5 and 5.0 for the same asset emphases. In terms of profit maximization, expert panelists who represent the design-build profession listed organizational assets at 4.5 and competence assets at 4.0 which was similar but not identical to that of the owner experts, who listed motivational assets first (at 4.75), competence assets second (at 4.50) and organizational and financial assets third (both at 4.00).

The fourth sample firm in the construction category is the design-build firm with 2000 employees concentrating on “green” sustainable projects. As stated earlier, this firm, when focused on continuity and longevity, was judged to be concentrating more heavily on competence assets (at a mean value of 4.90), followed by organizational (at 4.57) and motivational (at 4.43). With strategic operating focus shifted to short-term profit maximization, the expert panelists scored competence assets as the most emphasized class of resources (with a mean value of 4.48), followed by motivational assets at 4.05. Design-build members of the Delphi group assessed organizational and competence assets as the most emphasized classes (as did architectural panelists), but owner experts were not as sanguine and scored competence at 4.75 and motivation at 4.50, followed by financial assets at 4.25. The Delphi groups design-build contingent also scored organization and competence assets as the most emphasized when the firm’s focus shifted to profit maximization, at 4.75 and 4.50 respectively.

The Delphi expert panel was also asked, in successive rounds, to identify individual assets (not overall categories) from list of assets provided by the researcher under each of the seven classes of tangible and intangible assets. The resultant assets (those that received two votes or more) are shown in rank order in the next chart. To corroborate the individual asset selections with asset class emphases data shown earlier in the radar charts, individual assets were “rolled up” into categories found in the second part of the chart, and a brief discussion of the similarities and differences is found in the next section of this chapter.

Table 42 Individual Asset Selections for Firms (from Delphi Panel) and Individual Asset Relationship to 7 Asset Categories

	400 Person Engineering Firm	**4,000 Person EPC Firm**	**20 Person A/E Firm**	**200 Person Road Const Firm**	**20 Person Light Commercial Bldg Firm**	**2,000 Person "Green" Design-Build Firm**
Individual Assets with Multiple Votes (from Survey # 3 EXP – *only assets receiving at least two "votes" by the expert panel are listed*) Note: this portion of the chart shows actual selections by Delphi panel members	(11) Human Assets (6) Prof Skills/Profic (3) Technolog (4) Projects & Contracts (5) Embed. Know-How (2) Repeat Customers (2) Exper & Tacit Knowl (2) Purpose, Vision, Strat	(9) Projects & Contracts (5) Prof Skills/Profic (2) Adoption of Technol (2) Embed Know-How (2) Financ Investments (2) Organiz Structure (2) Organiz Processes	(9) Human Assets (8) Prof Skills/Profic (6) Innovat & Creativity (4) Brand & Reputation (2) Leadrshp Effectivness (2) Collectiv Know-How (2) Projs & Contracts	(15) Cash & Equity (7) Mobile Equipmnt (5) Insurance & Bonding (4) Machinry & Tools (2) Projects & Contracts (2) Exper & Tacit Knowl	(7) Experien & Tacit Kno (6) Projects & Contracts (6) Cash & Equity (3) Human Assets (2) Informal Routines (2) Leadrshp Effectivenes (2) Receivables	(8) Human Assets (7) Innovat & Creativity (5) Use of Technolog (3) Purpose, Vision, Strat (2) Brand & Reputation (2) Pro Skills/Profic (2) Projects & Contracts
Categories Represented by Choices of Individual Assets (Category and Assets per Category) Note: this portion of the chart was compiled by the researcher	Competence: 21 assets Organization: 5 assets Legal/Regist: 3 assets Motivation: 2 assets	Legal & Regis: 9 assets Competence: 7 assets Organization: 6 assets Financial: 2 assets	Competence: 19 assets Motivation: 14 assets Organization: 4 assets Legal/Regist: 2 assets	Financial: 20 assets Phys Produc: 11 assets Legal/Regist: 2 assets Competence: 2 assets	Competence: 10 assets Financial: 8 assets Legal/Regist: 6 assets Motivation: 2 assets Organization: 2 assets	Motivation: 10 assets Competence: 10 assets Organization: 7 assets Legal/Regist: 2 assets

By allocating the individual assets chosen by the Delphi expert panel members for each of the six sample firms to the seven tangible and intangible asset categories, it is possible to provide a “bottom-up” cross-check of the consensus score reached earlier (see composite scores shown in radar charts of Section 8.2 of this Chapter). The Delphi panelists identified 21 competence assets as vital to the operation of an engineering firm of 400 employees concentrating on infrastructure projects. These selections, taken from the open-ended questions in part 2 of the Delphi questionnaire, affirmed the composite findings which culminated in emphases on competence assets for what was uniformly assessed as a value shop professional design firm.

However, for the second of six sample firms (EPC firm of 4,000 employees concentrating on industrial projects), the individual assets question -- when allocated to the seven asset categories -- did not affirm earlier findings. Instead, the asset class garnering the highest score from the open-ended individual assets question for this EPC firm was legal and registrable assets (9 assets identified), followed by competence assets (7) and organizational (6). This outcome compares to competence, organizational and motivational as most emphasized in rank order by the results of the primary portion of the questionnaire.

The third sample firm – an A/E firm with 20 employees concentrating on institutional building projects – was allocated 19 individual competence assets, closely resembling the outcome of the sample engineering firm. This finding from the open-ended individual assets question affirmed the selection of competence assets through the successive rounds of the Delphi questionnaire. Motivation assets (14) received the second highest score, which also agreed with the overall composite scoring from the questionnaire.

The fourth sample firm, which is a road construction firm with 200 employees, also tracked consistently with the overall Delphi survey results for tangible and intangible asset categories. For this value chain firm, the panelists named individual financial assets 20 times, which affirmed the findings of asset category emphases which was the primary focus of Phase II of the research methodology. Also consistent with the Delphi panel scoring was the second most emphasized asset category of physical produced assets (11).

The fifth sample firm is composed of a small construction firm (20 employees) concentrating on light commercial projects. When asked in an open-ended question about individual assets used by the firm, Delphi panelists chose assets in the competence category (10 assets), financial category (8) and the legal/registrable category (6) . However, the overall questionnaire results for asset category selection showed emphases in rank order of competence, motivation and financial classes of assets. Nevertheless, there appears to be general affirmation of the composite findings from this "bottom-up" cross-checking of results.

The sixth and final sample firm is a hypothetical design-build firm with 2,000 employees concentrating on green and sustainable projects. Individual asset selections by the Delphi panelists nested in the categories of motivation (10 selections), competence (10) and organizational (7). Once again, this open-ended question tabulation tracked consistently with the composite scoring that was the primary focus of Phase II of the research methodology, with the asset category emphases ranked as competence, motivation and organizational.

8.5 Interpretation, Reflection and Analysis

This study, following the precedent of several studies looking into resource-based theory of the firm, treats firm performance as multidimensional, and it endeavors to explain the association between firm resources and market-based performance. But instead of assuming a thriving economy and trying to uncover companies that deliver "excess profits" (which is fine for a growth economy, but not for a survival economy), firm success is predicated upon the more-or-less opposing poles of continuity and longevity and short-term profitability. Because of this departure from conventional resource-based research inquiry, this study may not corroborate previous findings. One study uncovered during the literature search had a similar dichotomy: Spanos and Lioukas found that firm assets had a positive association with market performance, but also found that these resources were non-significantly associated with profitability (Spanos and Lioukas 2001).

The hypotheses developed for this study reflect general suppositions theoretically predicted by resource-based theory and by newer permutations of production theory. The study does not include all aspects of either theory, but is instead predicated on selected resources that may be representative of the domains. Therefore, generalization of any findings and conclusions must be advisory in nature, rather than consummate. Most previous studies have also focused on a limited number of specific assets, either on traditional tangible resources or separately on intangible resources. Despite the limitations recounted in this study, firms do not compete on the basis of one or two assets; rather they operate through a blending of multiple assets (Foss 1998). If resources are the building blocks of a firm's success in an economic system, verifying which assets are more important requires data from across the system, including both tangible and intangible resources (Mehra 1996; Galbreath 2004).

In order to show consistency or lack of consistency in the Delphi survey responses, a statistical test involving the calculation of Kendall's Coefficient of Concordance (W) was conducted. The coefficient ranges from 0 to 1, with 1 indicating complete inter-rater agreement, and 0 indicating complete disagreement among the expert panel or sub-group (Chan et al 2001). For the third Delphi round, there were 21 experts remaining on the Delphi panel, with attrition from the start of the qualitative portion of the study of 3 persons (the original Delphi panel before the start of round one included 24 experts). Results indicated high agreement among the panel about the asset emphases of the engineering ($W = 0.809$), EPC ($W = 0.753$), architectural ($W = 0.834$), light commercial construction ($W = 0.664$) and design-build (W = 0.658) sample firms chosen for the study when the firm goal was continuity and longevity. Only the road construction sample firm of the six firm types was scored lower, with an average concordance at W = 0.401. When the firm's goal was changed to short-term profit maximization, there was average agreement among the raters, including W = 0.551 for the engineering firm, W = 0.404 for the EPC firm, W = 0.579 for the A/E firm, W = 0.375 for the light commercial construction firm and W = 0.346 for the design-build firm. The solitary firm receivinga lower level of concordance was the road construction firm, with a score of W = 0.221, which was still significant where k = 21, N = 7 and the critical W value is 0.136. For critical W values, please see the chart at the conclusion of Appendix XX.

Table 43 Kendall's Coefficient of Concordance for Six Firms Focused on Continuity and Longevity versus Short-Term Profit Maximization

Categorization of surveys	N	Kendall's W
Firm A	21	0.809
Firm B	21	0.753
Firm C	21	0.834
Firm D	21	0.401
Firm E	21	0.664
Firm F	21	0.658
Firm G	21	0.551
Firm H	21	0.404
Firm I	21	0.579
Firm J	21	0.221
Firm K	21	0.375
Firm L	21	0.346

Based on composite scoring by the Delphi expert panel (after three rounds of responses), value shop firms in the study (engineering and architectural firms) emphasize competence assets first, followed by organizational and motivation assets. All seven categories of physical and financial assets are – according to the expert panel -- deployed by the A/E firms, but competence assets are nearly two times more important than financial assets for the sample firms.

By contrast, a value chain construction firm focused on road projects emphasizes financial assets in its business activities, followed by physical produced and organizational assets. Competence and motivational assets are still important to this value chain entity, but regardless of whether managerial focus is on continuity and longevity of the firm or on short-term profitability, the financial asset classification would receive the most attention, according to the 21 person expert panel participating in this phase of the research.

When the expert panel is decomposed by design/construction professional discipline, there is a high degree of concordance amongst the five identified professions about the asset emphases of design firms, construction firms and integrated design and construction firms when the stated goal of the sample firms is continuity and longevity. Such concordance falters however, when the firm's state emphases shift to short-term profit maximization. Engineers and constructors tended to give lower, but still significant scores to the sample firms; particularly integrated delivery firms (EPC and design-build). Other scores show average agreement among the expert raters when asked to score the firm's asset emphases when the stated goal is short-term profit maximization. A complete tabulation of the scoring by various clusters of Delphi experts follows:

Table 44 Kendall's W Based on Professions Represented on Delphi Panel When Scoring Asset Emphases of Sample Firms

Hypothetical Case	Professional	N	Kendall's W
Firm A	Engineers	6	0.843
	Architects	3	0.932
	Constructors	4	0.743
	Design-Builders	4	0.979
	Owners	4	0.739
Firm B	Engineers	6	0.836
	Architects	3	0.857
	Constructors	4	0.63

	Design-Builders	4	0.984
	Owners	4	0.739
Firm C	Engineers	6	0.836
	Architects	3	0.958
	Constructors	4	0.783
	Design-Builders	4	0.91
	Owners	4	0.792
Firm D	Engineers	6	0.521
	Architects	3	0.582
	Constructors	4	0.328
	Design-Builders	4	0.631
	Owners	4	0.581
Firm E	Engineers	6	0.75
	Architects	3	0.837
	Constructors	4	0.668
	Design-Builders	4	0.689
	Owners	4	0.787
Firm F	Engineers	6	0.746
	Architects	3	0.913
	Constructors	4	0.901
	Design-Builders	4	0.818
	Owners	4	0.43
Firm G	Engineers	6	0.673
	Architects	3	0.77
	Constructors	4	0.497
	Design-Builders	4	0.537
	Owners	4	0.639
Firm H	Engineers	6	0.316
	Architects	3	0.598
	Constructors	4	0.463
	Design-Builders	4	0.499
	Owners	4	0.633
Firm I	Engineers	6	0.739
	Architects	3	0.72
	Constructors	4	0.431
	Design-	4	0.555

	Builders		
	Owners	4	0.735
Firm J	Engineers	6	0.25
	Architects	3	0.754
	Constructors	4	0.221
	Design-Builders	4	0.517
	Owners	4	0.463
Firm K	Engineers	6	0.449
	Architects	3	0.659
	Constructors	4	0.3
	Design-Builders	4	0.625
	Owners	4	0.678
Firm L	Engineers	6	0.23
	Architects	3	0.671
	Constructors	4	0.41
	Design-Builders	4	0.442
	Owners	4	0.646

The EPC and design-build firms that do not clearly fit either the value chain or value shop production logic -- but instead have a blend of the two value logics (specifically, the sample EPC and design-build firms identified in the study) – have additional industry implications and are discussed in more detail in the final chapters of this thesis.

"It's not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change." __ Charles Darwin, 1872

"The real voyage of discovery lies not in seeking new landscapes but in having new eyes" ___ Marcel Proust, 1919

CHAPTER 9 RESULTS, EMERGENT FRAMEWORK AND ILLUSTRATIVE SCENARIO

9.1 Elaboration and Extension of Quantitative and Qualitative Findings

Researchers infer from empirical details, and *to infer* means to use reasoning to pass judgment or to reach a reasonable conclusion based on evidence (Neuman 2003). With mixed methods research, and particularly with a phased quantitative – qualitative approach, the researcher will conceptualize variables and work with measurement of variables in an initial phase, followed by formation of new concepts or refining of existing theoretical concepts in the second phase. In phase II of this research project, the concept of economic factor inputs was organized through thematic coding; that is, tangible and intangible assets were placed in manageable categories that attempted to capture the richness of the phenomenon (Boyatzis 1998). Through this thematic coding, concepts [such as corporeal (tangible) and volitional (intangible) asset classes] can be analyzed, interpreted and presented (Boyatzis 1998).

In his book *A System of Logic*, John Stuart Mill described logical methods for making comparisons, including analytic and nominal comparison (Mill 1843). Mill's method of agreement eliminates cases that are not shared across the spectrum of cases, and includes looking for one or more similar or identical causes to explain the common outcome. By looking for consistent patterns, properties that are absent when the outcome is observed are not necessary conditions for the effect. A second method of induction described by Mill is the method of difference, in which cases subject to the study are similar in many respects but may differ in a few crucial ways. The method of difference reinforces information from positive cases (where there are common causal features and outcomes) with negative cases where the relationships between outcome and causal features are lacking (Neuman 2003). With the method of difference, the researcher unearths cases that have many common positive causal features, but also have some key differences that may lead to an alternative outcome.

At the conclusion of this chapter, mental models (at least one of which could be an *ideal type* as Max Weber would have termed it) are provided as *illustrative scenarios*. The scenarios are consistent and coherent discriptions of alternative hypothetical futures that reflect different perspectives, or potential future developments and can serve as a basis for organizational action (Van Notten 2005). Scenarios, such as ideal types, can be used as benchmarks to explain deep structures and underlying mechanisms, but they not provide a definitive test or explanation. Instead, these models can be used to guide the conceptual reconstruction of a mass of details into a systematic format (Stinchcombe 1973).

9.2 Discussion of Theoretical Implications: Asset Accounting (Resource-Based Theory) with a Value Logic (Production Cycle) Overlay and Other Implications

Measurement of intangibles and human capital, which are important for both goods-producing and service-producing industries, has been a challenge for statisticians; and the growth of the "new economy" has made responding to this challenge even more important (Abowd et al 2005). Direct measures of intangible and human capital are difficult and the research approach has been to find proxies for non-tangible assets that account for organizational capabilities, competence of collective and individual employees with organizations, and motivation, leadership and creativity of the organization and its employees. There is a relatively small set of recorded characteristics of workers, and those that have been previously used, such as measuring a college degree to show the knowledge intensity of a firm's workforce, fails to capture the difference in individual drive and ability, quality of the university or college attended or rigor of the program of study (Aaronson and Sullivan 2001).

The relationship between inputs and outputs is summarized by the traditional production function but can be augmented with explicit recognition of intangibles and human capital by the following specification (Corrado et al 2005):

$Y_{jt} = F_j\,(K\ T/jt,\ K\ I/jt,\ H_{jt})$

where Y_{jt} is output per worker at firm j at time t, $K\ T/jt$ is tangible physical capital per worker, and $K\ I/jt$ is intangible capital per worker, and H_{jt} represents the distribution of human capital among the workers at the firm.

Despite the breakthrough of encompassing human assets along with physical and financial assets of the firm, the problem with the econometric equation is that it captures only current production as opposed to looking at a firm's long term sustainable future. For example, if a firm is building for its future, such as investing in expensive new software and training personnel to operate the new software, the firm may exhibit lower current performance in terms of short term profits and lower worker productivity. Nevertheless, researchers associated with the Bureau of Economic Analysis found that firms with a top quartile of skilled workers had disproportionately higher market values than those firms in the lower three quartiles (Abowd et al 2005).

9.3 Discussion of Managerial Implications: How Do Organizations Identify and Assess Their Intangible and Dynamic Assets, Including Knowledge/Competence Assets? How Can a New Holistic View of a Firm's Asset Base Help Management?

The literature review conducted for this research (Chapter 2) discusses structure, conduct and value-producing attributes "at the local level" where firms position themselves as competitive value-creating enterprises within an economic system. Using ideas from Thompson, Porter and Stabell & Fjeldstad, a parsimonious typology of firm production logics is described and built upon (Thompson 1967, Porter 1985, Stabell & Fjeldstad 1998). To complement these distinct operating styles and to provide an intersection between production logic and firm resource acquisition and deployment, a framework of firm resources consisting of seven tangible and intangible asset categories was developed and explained (Chapters 4 & 5). These asset group frameworks have a long history of theory and application, including by Smith (1776, 1976), Mill (1863), Menger (1871), Ricardo (1817), Penrose (1959), Sveiby (1987), among many others. Marr augmented the structural theory of the firm with the statement that "firms are bundles of assets" according to resource-based theory (Marr 2003). The framework used in this research updates and expands upon those schemes in an effort to better reflect attributes and true nature of modern firms in the contemporary economy.

When firms attain a more complete cognizance of their total asset base, they better understand the interplay among the tangible and intangible assets under their control or influence, as well as those of their customers:

- For value chain firms of the A/E/C sector, such as construction firms that self-perform much of their work with production processes that resemble manufacturing (e.g., large construction firms concentrating on repetitive work such as road building or tract housing construction), the emphasis will likely be upon monetary and physical assets. There will likely be a push for economies of scale and standardization through careful coordination of sequential activities. Although capacity utilization and output production are paramount to the value chain firm, technology adoption and human resource management can be market differentiators for these firms, providing competitive advantage, longevity and continuity.
- When considering value shop firms in the A/E/C sector, such as architectural and engineering design firms, the production process is primarily guided by knowledge intensive resources. Larger firm size is not necessarily better and market share is not universally desired, as long as prices for output are variable (i.e., not commoditized) rather than fixed, predictable and widely-known in the marketplace. The competence assets of these firms are concentrated on problem solution rather than production of products, which helps move their customer from a current state

of being to a more desired state. The application of resources is not linear but rather iterative, with cycles of effort often involving multiple disciplines and specialties who build upon each iteration toward a full solution.

- With regard to finding value networks in the A/E/C sector, this research failed to uncover evidence of architecture, engineering or construction firms employing the value network operating logic. Value network-based organizations concentrate on linking customers, often through technological services capacity that helps to connect numerous customers through time and space. The network encourages interconnectedness and exchanges among the users of the network usually through the waypoint of the host provider, either for regular, constant users or for occasional and random users. Currently, there is little actual or even anecdotal evidence that this model (that is, the value network model) is being adopted by A/E/C organizations.

Assets are strategically important to the firm as it plans for growth or to take advantage of emerging markets, as well as for the economic rents that assets can generate (Peteraf 1993). Firms that ascribe to the resource-based theory are often rent-seekers rather than profit maximizers, and there is an incessant quest to find new competitive advantages to sustain existing market share (Teece 1997). Often, firms are "stuck" with the resource base that they have in possession, because they lack the organizational capability of developing new competencies quickly, or because competence assets are not readily tradable (Dierickx and Cool 1989). But resource-based theory seems to encourage a total assets view with special emphasis on previously uncounted and unreported assets. As noted in Chapter 5, there has been an evolution from meta-level asset classes (land, labor and material) as discussed by Adam Smith, David Ricardo, Karl Marx and numerous other economists, to a mid-twentieth century macro-level view of resources that can be characterized by the five Ms (Machines, Money, Minds, Motivation and Milieu [or macro-environmental resources]). Recently, building on the work of Teece, Sveiby, Roos and others, this research has precipitated seven asset classes that encompass all of a firm's potential asset base, whether those assets are owned, controlled, partially controlled or influenced (including financially, socially and environmentally) by the entity and either held for value or used in the production process.

One of the most compelling challenges for scholars and practitioners interested in resource-based theory is assessing the profile of core resources and capabilities (Carmeli 2004). A firm is viewed as a bundle of resources, and the accumulation and deployment of physical, financial and organizational assets are the basis for executing management's goals (Penrose 1959, Lawrence 2009). Different firms possess different bundles of productive resources because some assets are relatively immobile or costly to copy, so there is at least some degree of heterogeneity among firms (Barney 1997). Assets, whether tangible or intangible, are related and linked to one another, and these relationships and interplays among resources either expand or contract the strategic options available to the firm (Barney 1994). In *Measuring Capital in the New Economy*, researchers for the Bureau of Economic Analysis recommended that additional categories of assets be added to traditional physical and financial assets for national accounts and where possible to firm-level measurements: inventive and creative activities, knowledge embedded in firm-specific human and structural resources, and computer-based information in the form of databases and software programs (Corrado et al 2005).

Beginning in the mid-1990s, the European Union began compiling a KLEMS database of asset inputs and outputs, which is an acronym for capital (K), labor (L), energy (E), materials (M) and services (S) (Strasser et al 2005). The problem of measuring output is much more challenging in services-producing than in goods-producing industries (O'Mahoney and Timmer 2009). Much of services activities are intangible, more heterogeneous than goods and often dependent on the action of the customer as well as the producer, and hence a distinction should be made for services that are market-traded (measurable in dollars) and for the balance of service activities (likely the majority) for which no prices exist (O'Mahoney and Timmer 2009). Statisticians in Canada and parts of Europe have begun to integrate labor and intangible capital services into production accounts, as well as [for the first time] expanding factor inputs and production outputs to include environmental [heretofore external] effects (Baldwin and Harchohaoui 2005).

At the firm level, parallel micro-economic data on production logistics and on asset accumulation and deployment as compared to output may have multiple implications for management. For day-to-day management of the firm, asset inventory information informs key managers about productive or strategic use of available resources, whether the stocks and flows of these assets are appropriate given production needs, and whether the supply chain furnishing the stocks should be accelerated and increased, or whether some asset stocks should be reduced and the resulting financial capital used for other corporate purposes. Management can also pursue differentiation and gain competitive advantage through emphases on deployment of intangible assets, because recent research has shown that firms with a similar employee base and balance sheet may experience significant differences in performance due to firm-based non-tangible resources as customer retention or market recognition (Roos et al 2005).

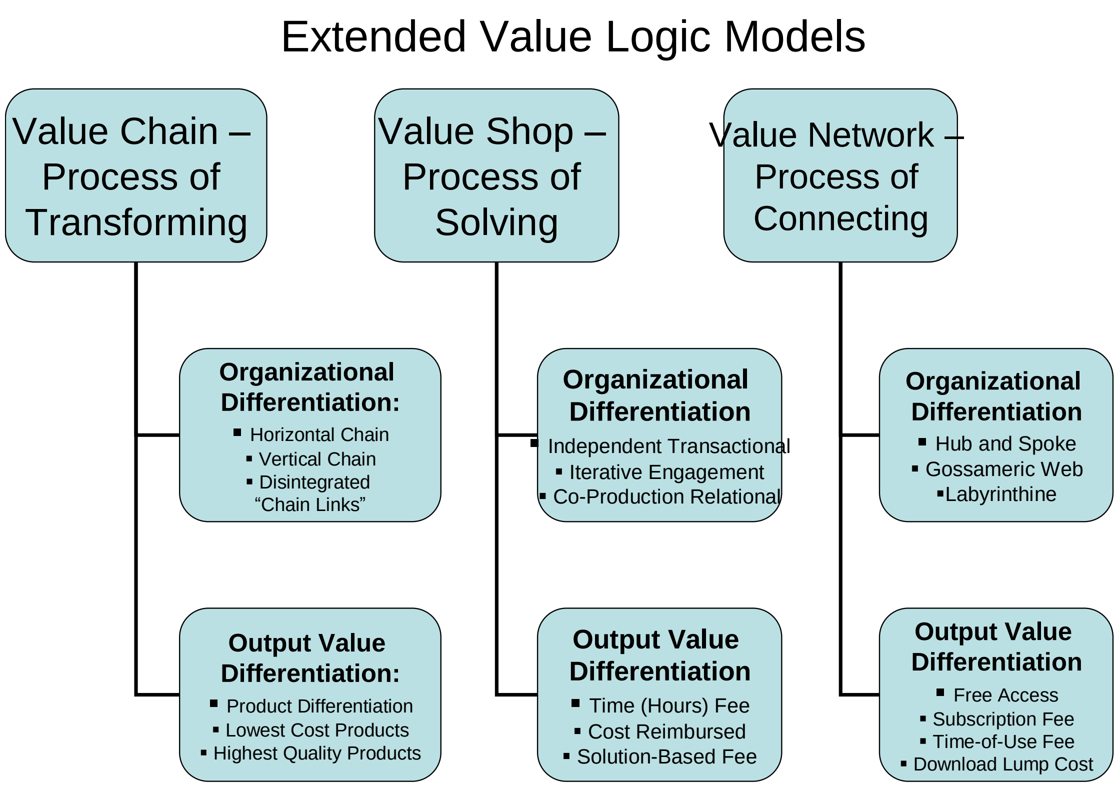


Figure 26 Extended Value Logic Models for Strategic Management

When considering strategic directions for the firm, such as with a merger, acquisition or spin-off, due-diligence should uncover not only physical and monetary resources and processes, but intellectual capital, relational resources, cultural attributes, innovative activities and adoption of technologies. These additional categories are found under "volitional assets" as defined by this research. To help to determine if the new alliance will work over time, the degree of intellectual capital within a firm can provide insight into whether the new combined venture will be path-dependent or path-breaking in terms of output of new products and services (Sudarsanam 2003). Driving much of the interest in mergers in the A/E/C industry has been the concept of synergy, whereby the benefits arising out of the blending of two systems of resources provides greater return than simply the sum of the two parts (Gaughan 2007).

9.4 Agenda for Change: Toward a Total Assets Balance Sheet -- Emergent Formats for an Organizational Total Asset Account (OTAA) and with Proposed Templates for Intangible Assets Budgets, Capabilities/Deployments (similar to Income/Expense) Reports and an Intangible Assets/Liabilities Balance Sheet

In dealing with the input-output relationships of firms, it is important to recognize the primary, secondary, tertiary and more recently the ascendance of the quaternary mega-sector of the economy (Kennessey 1987). The quaternary sector describes the knowledge-based portion of the economy that includes services for information generation and sharing, information technology, consultation, education, research and development, financial planning and other organizational and knowledge based activities (Selstad 1990). In classical economic literature, the primary sector consisted of extractive and farming industries, the secondary of processing or manufacturing industries, and the tertiary of transportation and utility services as well as wholesale and retail trade (Kuznets 1973). The tertiary sector [and also the quaternary sector is implied] has always been the stepchild of economic research, which may have been tolerable in the 19th and early 20th centuries, but today there are newer priorities (Kennessey 1987). Kuznets raises the possibility of sector mis-equilibrium, where one sector may decline in total output measured in dollars compared to another but continue to require significant resources [such as physical natural resources] (Kuznets 1973). As pointed out in Chapter 3, previous models have failed to encompass all resources available to firms, such as those assets that may not be under direct control through ownership, but are nevertheless used as primary or intermediate inputs in the firm's production process. A contribution of this research is to provide a holistic template that acknowledges and categorizes the available and unreduced palette of assets that are deployed in production of goods and/or services; and these assets are included whether they are directly controlled, partially controlled or indirectly influenced by the firm whenever they have been clearly included in their production process.

Once those assets under a firm's control or influence have been identified, the next step is to develop credible ways for measuring and comparing assets. One researcher suggested that in some manufacturing concerns that are highly dependent on physical natural assets, only about a twelfth of the material flows are valued in monetary units (Stahmer2000). Because of that shortcoming, Stahmer argues that a complete description of interactions between human beings and nature must be given in physical units, such as tons, joules and hours, rather than in dollars (Stahmer 2000). The resulting three asset summaries (economic with the common denominator of dollars; social with the common denominator of hours; and environmental with the common denominator of quantities) would help triple bottom line accounting if a method could be devised to compare inputs and outputs among the three resource domains.

Bontis has stated that a real formula for intellectual and knowledge capital may never exist, but through adoption of both quantitative and qualitative research, relative indicators can emerge (Bontis 2001). Because traditional financial statements are less informative about the firm's current condition and future prospects, it is sensible to enhance their usefulness by developing complementary statements that recognize intangible assets (Canibano et al 1999). One obvious observation is that financial statements may have retained their reliability but have lost some of their relevance in the new economy, resulting in greater gaps between market value and book value, and perhaps even more perplexing, between going concern value and book value. Adding intangible asset evaluations to management accounting reports – both from a top-down survey and verification perspective and from a bottom-up record-keeping perspective can help fill this information void. Although no consensus exists on how to create and organize such data, draft definitions, classifications, compilations and comparisons can begin to reveal the strategic management implications of intangibles in conjunction with the good financial accounting processes that already exist.

In 2006, the American Institute of Certified Public Accountants released an exposure draft of an *Enhanced Business Reporting Framework for Private Companies* to assist firms in better communicating with key internal and external stakeholders about business strategy and expected performance (AICPA 2006). Part C of the AICPA Framework specifically recommends discussion of both physical/financial and intangible (i.e., relationship/social capital, organizational/structural capital and human capital) for potential future reporting. The proposal stopped short of looking into production or value logic, despite some researchers' suggestions that disclosures should reveal business models of companies (Bukh et al 1999, Eccles et al 2001).

The following proposed formats for individual firm reporting developed by this research project attempt to overcome those shortcomings and move the discussion beyond simple "topics of discussion" as in the AICPA draft. Using the Stabell-Fjeldstad value logic classifications plus the total asset model developed for this research (see Section 6.8), five steps are identified for firm-based total asset accounting:

Step 1 – Set up parallel financial (tangibles) and capabilities (intangibles) budgets for the upcoming period (often one year, three years or five years).
Step 2 – Use information from a "Prior Year Survey" of all employees to generate time-based allocations of work-related activities.
Step 3 – Generate a capabilities/deployments statement to gauge accumulation utilization of time-based assets as well as related quantities-based intangible assets for review by management alongside same-period income-and-expense statements.

Step 4 – Develop an intangible assets inventory (but acknowledge the extremely rapid depreciation of some intangible assets);

Step 5 -- Create an intangible assets balance sheet to be used alongside the financial balance sheet to inform management about the relative health and dexterity of the firm.

Table 45 OVERVIEW OF
PROPOSED STEPS FOR "TOTAL ASSETS" MANAGEMENT ACCOUNTING

"TANGIBLES" ACCOUNTING for Corporeal Assets	**"INTANGIBLES" ACCOUNTING for Volitional Assets**
Financial Budget in dollars $ -- measured in transactions plus other quantities *q*	Capabilities Budget in time *t* – measured in time-based activities plus other quantities *q*
Income and Expense Statement – with current year capital acquisitions/divestitures listed at the end of the statement	Capabilities/Deployment Statement – with current year capital accretions/depletions listed at the end of the Statement
Financial Balance Sheet, reflecting increases and decreases including "tangible" financial assets, physical produced assets, physical natural assets, and to the extent that they are legally recognized: legal and registrable assets such as trademarks and patents	Capabilities & Intangible Resources Balance Sheet, including accretions and depletions of "intangible" organizational assets, competence assets and motivation assets, plus intellectual property assets that do not have legal status (not copyrighted, trademarked or patented) [see legal/registrable under "Tangibles" Accounting for Corporeal Assets]

A firm's Capabilities Budget can be initiated by conducting a prior-year survey of all firm employees in order to allocate, based on percentage of time spent on various organizational activities. Because employees already complete time sheets weekly (this information is used in the financial accounting (income statements) to record time devoted to what is produced (goods and/or services) by the company; the capabilities (intangible asset-oriented) annual survey will instead focus on how these goods and/or services are produced by asking employees to estimate percentage of time spent on specific types of organizational activities. This approach mirrors -- at a micro-economic level -- what the Bureau of Economic Analysis is attempting to accumulate to have a better picture of the U.S. economy at a macro-economic level through its "System of National Accounts" (Jorgenson et al 2006). A suggested employee survey for compiling data for the Capabilities budget would consist of the following questions:

Table 46 [PROPOSED] ANNUAL EMPLOYEE SURVEY FOR CAPABILITIES/DEPLOYMENT

Name: ___________________________________
Title: _________________________________
Division: ________________________________
Department: ______________________________
Primary Work Activity: ____________________________

Instructions:
Of your total time working for XYZ company this year, please indicate the percentage of time devoted to each of the 3 areas (Area I = Organizational Activities, Area II = Competence Activities, Area III = Motivation Activities). If you spent zero time in any one of the 11 activity areas, make sure that you record a "zero" within that cell, as long as you have sufficient cells completed to reach 100 percent.

During the year, weekly timesheets already record "what" you are doing; the purpose of this survey is to help human resources to understand "how" you are doing all of the activities that make our organization productive. Please note: The total of all percentages by the end of the survey (total of all 11 categories) should sum to exactly 100 percent.

Area I -- "INTANGIBLE" ORGANIZATIONAL ACTIVITIES (four categories)

#1 IO-1	Organizational Processes, as in time devoted to items such as:	Estimate of % of total time	Comments
	Formal Work Processes, Internal Routines & Systems, Execution of Business Strategy, or General Production of Goods or Services.		
#2 IO-2	Organizational Structure activities, such as those listed here:	Estimate of % of total time	Comments
	Legal Structure and Firm Risk Issues, Management Structure, Contracts/Projects Planning and Risk Eval, Calculating Going Concern Value.		
#3 IO-3	Organizational Technological activities, such as those listed here:	Estimate of % of total time	Comments
	Adoption of IT Culture, Software Adoption,		

	Other New Technologies, or Use of Web/Virtual Networks.		
#4 IO-4	External or Relational activities, such as those listed here:	Estimate of % of total time	Comments
	Brand and Reputation, Maintaining Customer Base, Conducting Outreach Measures, or Cultivating Repeat Customers.		

Area II -- “INTANGIBLE” COMPETENCE ACTIVITIES (four categories)

#5 IC-1	Human Assets Development, as in time devoted to items such as:	Estimate of % of total time	Comments
	Education, Professional proficiency and skills, Learning use of new technologies, Expansion of special talents, or Retention or promotion of employees.		
#6 IC-2	Continuing Development activities (individual or group), such as listed here:	Estimate of % of total time	Comments
	Training, Team Experience, Interaction w/ Customers that adds learning, Knowledge Management and Acquisition.		
#7 IC-3	Embedded Know-How and Procedures activities, such as those listed here:	Estimate of % of total time	Comments
	Activities contributing to collective knowl, Development of new group routines or procedures, Mentorship or “deep” interaction leading to employee growth.		
#8 IC-4	Culture and Commitment activities, such as those listed here:	Estimate of % of total time	Comments
	Activities to foster attitudes, values and trust, Esprit de corps and loyalty, Sustainable practices (environmental, social and financial), or Adaptiveness in helping firm/exployees adapt to business changes.		

Area III -- “INTANGIBLE” MOTIVATION ACTIVITIES (three categories)

#9 IM-1	Leadership activities, as in time devoted to such items as:	Estimate of % of total time	Comments
	Internal and external leadership effectiveness, Entrepreneurial activities, Organizational integrity, or Strategy, communication of strategy and execution of strategy.		
#10 IM-2	Innovation and Creativity activities, such as those listed here:	Estimate of % of total time	Comments
	Developing or maintaining culture of innovation, Fostering internal rewards for creativity, Obtaining challenging projects or design opportunities, and Gaining external recognition for functional or aesthetic attainment.		
#11 IM-3	Purpose, Vision and Strategy activities, such as those listed here:	Estimate of % of total time	Comments
	Testing and updating firm value proposition, Developing and articulating vision for firm or department, Gaining acceptance of vision or strategic plan, Guiding firm toward products and services to meet existing and emerging markets.		
TOTAL	Total Current Activities (Deployment of Intangible or Volitional Assets During the Past Year) =	100%	

While employee time allocation data is vital to the compilation of the periodic capabilities/deployment statements, management will also want to “keep score” using a spreadsheet that will allow estimates of depreciation and relative value of intangible assets. To provide this compilation for recordation and review of a firm’s organizational, competence and motivational assets, draft formats are provided to tabulate the firm’s intangible data in the Appendix. Each of the three draft summary sheets (the first for organizational assets, the second for competence assets and the third for motivational assets) has cells for the management accountant to enter whether the asset group is fully present, partially present or not present, and to show whether the asset is enabling (held for productive purposes, but not used directly as a factor input), or effort-based (deployed directly during the production cycle). In addition, the management account is asked to estimate the intangible asset's projected service life, remaining service life and how much of the intangible asset group was actually deployed during the period. The chart also includes space for estimating the strategic and sustainable value of groups asset groups, with a final column devoted to "management action anticipated related to asset group or sub-group, with the alternatives of a.) add to stock, b.) status quo, c.) re-deploy, d.) reduce stock, e.) liquidate, or f.) other (explain action if a through e option is not selected). See Appendix XX for these three charts.

In addition to traditional financial income and expense statements, a firm concerned with total asset accounting would provide management with capabilities/deployment statements outlining intangible (volitional) assets to gauge the relative variances over time. After three or more years, good time series comparisons alongside financial income/expense reports should begin to emerge; however, the literature warns that the "pay-back" time horizons for intangible activities are longer and therefore side by side comparisons for shorter term (perhaps, less than three years) may not show trends or impacts of intangible resources adjustments reflected in financial statements (Corrado et al 2005). A suggested Capabilities/Deployment template could assume the following format:

Table 47 Proposed Template for CAPABILITIES/DEPLOYMENT STATEMENT
(for management use in conjunction with income and expense statement)

CAPABILITIES & INTANGIBLE RESOURCES	quantities		HOURS
Hours Available Firm-Wide *t*			
New Hours Acquired During Period *t*			
Other intangible resources not time-based in quantities *q*			
DEPLOYMENT			
IO-1 Organizational Processes, Routines and Production			
IO-2 Organizational Structure Activities, esp legal, risk, accounting			
IO-3 Organizational Technological, incl software, web, IT			
IO-4 External and Relational, e.g, outreach, brand and customer base			
IC-1 Human Assets Development, incl continuing education & training			
IC-2 Continuing Development, e.g., team experience, client interaction			
IC-3 Embedded Know-How & Procedures, esp new routines, mentoring			
IC-4 Culture and Commitment e.g., values, trust, sustainable practices			
IM-1 Leadership Activities, incl entrepreneurial, integrity, strategy			
IM-2 Innovation and Creativity, incl new products or systems			
IM-3 Purpose, Vision and Strategy, incl strategic plan, meeting market			
Other intangible resources not time-based in quantities q			
INTANGIBLE RESOURCES NOT TIME-BASED NET QUANTITY *q*			
TIME-BASED RESOURCES DEPLOYMENT NET HOURS *t*			

A Capabilities/Intangibles Balance Sheet can then be established with the accumulations of organizational, competence and motivation assets as identified by management, and as modified year-by-year through accretions and depletions as reported by the employees. These intangible assets, it must be noted, are based on going concern value; that is, they have little residual value if the firm is liquidated, and they are subject to much steeper depreciation declines that most physical or financial assets. Nevertheless, these assets represent the difference between the book value and the market value of some firms, or approximately ten to 30 percent of the firm's value (Lev 2001; Black and Lynch 1996).

A traditional financial balance sheet relies upon formal firm valuation and audit information, plus periodic income and expense statements, to build the asset stock snapshot created at the close of a fiscal year. Similarly, a capabilities/intangibles balance sheet can be assembled based on an evaluation of organizational, competence and motivation stocks (such as may be done by progressive management accountants in the wake of Sarbanes-Oxley), with annual adjustments made according to information found on capabilities/deployment statements compiled through annual employee surveys. Included below is a proposed template for an intangibles balance sheet:

Table 48 [Proposed] Template for CAPABILITIES & INTANGIBLE RESOURCES BALANCE SHEET

ASSETS: CAPABILITIES & INTANGIBLES	Asset Level *t*	Less Deprec	Net Asset *t*	Comments
IO-1A Accumulated Organizational Processes				
IO-1C Current Organizational Processes				
IO-2A Accumulated Org Structure Activities				
IO-2C Current Org Structure Activities				
IO-3A Accumulated Technological				
IO-3C Current Technological				
IO-4A Accumulated External or Relational				
IO-4C Current External or Relational				
IO-5 Other Org Assets Not Measured in *t*				
IC-1A Accumulated Human Assets				
IC-1C Current Human Assets				
IC-2A Accumulated Competence Development				
IC-2C Current Competence Development				
IC-3A Accumulated Know-How & Proced				
IC-3B Current Know-How & Proced				
IC-4A Accumulated Culture & Commitment				

IC-4C Current Culture & Commitment				
IC-5 Other Competnce Assets Not Measured in *t*				
IM-1A Accumulated Leadership				
IM-1C Current Leadership				
IM-2A Accumulated Innovation and Creativity				
IM-2C Current Innovation and Creativity				
IM-3A Accumulated Purpose, Vision, Strategy				
IM-3C Current Purpose, Vision, Strategy				
IM-4 Other Motivation Assets Not Measured in *t*				
TOTAL INTANGIBLE ASSETS				
LIABILITIES: CAPABILITIES & INTANGIBLES				
Depletion or Loss of Organizational Assets in *t*				
Depletion or Loss of Other Org Assets (non-time)				
Depletion or Loss of Competence Assets in *t*				
Depletion or Loss of Other Competence Assets (not *t*)				
Depletion or Loss of Motivational Assets in *t*				
Depletion or Loss of Other Motivation Assets (not *t*)				
Other Intangible Liabilities				
TOTAL INTANGIBLE LIABILITIES				
Plus Intangible Capital Stock & Retained Intangibles				
Sum to Zero				

9.5 Illustrative Scenario

In his business management book *The Art of the Long View*, Schwartz recommends coming to terms with scenarios from the inside out rather than from the outside in, due to the difficulty of incorporating the enormous complexity of the external states of nature as a scenario analyst builds alternative stories of potential eventualities (Schwartz 1996). Scenario planning recognizes that many factors can combine in new and complex ways to create a surprising future due to unexpected natural and man-made forces, deep shifts in collective values, new laws or regulations, technological breakthroughs and resulting products, or social stress due to economic recession or dire political instability. By challenging linear mindsets, scenario development helps managers anticipate organizational weaknesses that would be unable to cope with new challenges, plus uncover inflexible processes, methods cultures which are unable or unwilling to adjust to pressures that would harm the organization if it persists in its current trajectory (Shoemaker 1995).

A strategic plan typically only considers one possible scenario, which is often derived from past financial performance and simply projected -- based on trending -- into the future. Because this approach is normally based on traditional financial assets and current processes used by the firm, it fails to consider market changes, social trends, environmental and climate issues and other shifts in the world that can affect a company's health and performance. In the 1970s, some large multi-national companies like Royal Dutch Shell and General Electric began to rely on alternative scenario testing using long-range forecasting and computer models (Wack 1985). The theoretical importance of alternative scenarios was underlined by the widespread confusion following the oil shock of 1973 (Diffenbach 1983). Since that time, other newsworthy "shocks" were seen as potentially predictable if only researchers had explored improbable but nevertheless plausible events, such as the Twin Towers, Hurricane Katrina and Deepwater Horizon.

Scenarios are ways of developing options about how to deal with possible future events that are not necessarily predictable, and therefore subject to significant uncertainty. Use of scenarios has been criticized because the schemes may be arbitrary and not based on hard empirical data. An added detriment is the reduction of complex future alternatives down to two or three scenarios, which likely introduces a good degree of distortion because of content left out, or because of assignation of greater probabilities to one set of circumstances and lesser probabilities to other potential events (Shoemaker 1998). Examples of states of nature that can have effects on A/E/C projects are enumerated in The Selection Process for Capital Projects (Lang and Merino 1993):

- Trends in energy and environment – such as depletion of some energy stocks and emergence of new energy sources; and increasing stress on natural resources to the point of non-recovery and overuse of seas, land and air for waste sinks rendering portions of these environments unavailable for other productive or supportive use.
- World trade and global economy – such as not only exports and imports of goods among countries but also export or import of goods-producing capacity, where the maximum financial return can be provided to shareholders and management without consideration of all externalities and dislocations due to that movement of capital.
- Taxes and incentives – where taxes and tax policy is stable, businesses tend to adapt to an equilibrium; however if a tax on a major sector changes – such as if the deductibility of mortgage interest was repealed to help solve a gap in government revenue, home ownership may be discouraged and the sectors relying on home building or renovation may suffer; or if the gasoline tax that funds the transportation trust fund continues to decline relative to transportation funding needs due to use of other fuels (iincluding electric vehicles), it may have to be replaced with VMT (vehicle miles traveled) technology, which due to new assessed fees or taxes may change driving habits by encouraging people to lessen their commutes or to use public transit.
- Weather and climate – such as prolonged drought in an area that continues to increase in population, resulting in importation of water or construction of expensive and energy-intensive water desalinization plants; or changes in sea level that will flood low-lying areas of major cities, causing relocations or construction of flood management structures to retain portions of the urban area.
- Financial and economic – Because of recurring events such as business cycles or periods of low or infrequent regulation (or too much regulation), money supply expands or contracts, causing difficulty for some borrowers to find financing during a contraction. If the problem is severe, small and start-up businesses can be effectively closed out of the market by lenders, further exacerbating a slow economy.

- Influential new technology – where the utility or cost savings of new technological advances makes previous technology obsolete, such as high efficiency ground exchange or aquifer loop exchange heating system that requires much less energy and little maintenance to provide much more efficient heating and cooling than previous technologies; or a recycling system for a small municipality that takes care of 80 percent of the community's waste stream and sells the byproducts (e.g., metals, paper products, plastics) for sufficient funds to pay for the new system.

Under uncertainty, scenarios can be reviewed by decision-makers using various principles involving choice. Although use of decision trees and minimax/maximin approaches may be used by some, Lang and Merino recommend the more sophisticated Hurwicz and Savage (also known as regret) approaches (Lang and Merino 1993). The Hurwicz principle adds an alpha that represents a scale from pessimism (0) to optimism (1) so that a range of choices can be plotted. The points on Hurwicz graph will show cost or profit (y axis) plotted according to a coefficient of optimism (x axis). An expert group or top manager can look at the ranges and decide based on an intuitive feel of what is likely to occur, usually somewhere between abysmally pessimistic and wildly optimistic. Another method to help in decision-making under uncertainty is the Savage principle, which uses a regret matrix to show the minimum of regrets from a series of possible decisions. With this principle, one tries to select the alternative with the lowest loss that one would suffer if you find out later that you selected the wrong alternative. The loss could be computed for profits or for costs, but the decision may be altered depending on the different criteria. Because of its consensus-oriented nature of developing a coefficient of optimism (or pessimism) based on a Delphi expert group, the Hurwicz approach represents a reasonable principle of choice for a firm's large-scale make-or-buy decisions.

Some researchers claim that use of quantitative schemes for predictive decision-making may be appropriate in narrower areas where the focus is on, for example, cost or profit of a product line. But with multiple and complex issues confronted by organizations facing an uncertain future, it may be more appropriate to gain foresight through alternative scenarios through a process that is qualitative in nature (Schwartz 1996). Analytical tools, even ones that can model dynamic decision-making, are not able to model the more qualitative nature of high uncertainty (Alessandri et al 2004). Empirical evidence suggests that higher uncertainty is associated with a more behavioral approach to decision-making (Cyart and March 1963). The process of establishing scenarios frequently includes the following phases as adapted from Alessandri (Alessandri et al 2004):

- Identification of environmental, economic and social driving forces
- Selection of significant driving forces and estimating their likelihood
- Consideration of the combination of driving forces that may establish scenarios
- Naming of the scenarios and organizing them graphically
- Writing scripts (or stories) about the scenarios
- Analyzing the present to look at "weak indicators" that could become stronger
- Comparing scenarios and looking at each plausible outcome
- Considering organizational responses or adaptations to various outcomes

Van Der Heijden makes a distinction between external and internal scenarios, where external scenarios represent a range of possible future developments that are developed as mental models, and internal scenarios are developed at the individual or firm level and can be a series of "what ifs" that would lead to responses or adaptations (Van Der Heijden 2002). Among the more useful derivations from scenario planning is the identification of possible key events or turning points that would channel the future toward a particular outcome (Mietzner and Reger 2005). Five criteria have been advanced for selection of at least two, but no more than four, scenarios for a given situation (Wilson 1998):

- The selected scenario must be plausible; that is, be capable of happening;
- Each scenario should be structurally different, and not simply variations on a given theme;
- The scenarios should have internal logic to ensure that their credibility would be undermined;
- Each scenario should have specific insights on the future that provide information for decision-making or organizational response; and

- The scenarios [other than possible one of the scenarios being about an incremental status quo] should challenge the organization's conventional wisdom about the future.

As a precursor to assembling two-by-two charts of alternative external and internal scenarios, it is useful to set forth a context consisting of the current handful of paradigmatic drivers of change for the A/E/C industry. These drivers will serve as an ever-present backdrop to the possible futures portrayed by combinations of internal and external scenarios:

1. Technological – including Building Information Modeling (BIM) software, Personal Digital Assistants (PDAs), smart embedded computer chips
2. Economic – such as commoditization of previously custom or black-boxed services, global competition, swift erosion of market advantages
3. Social – including aging of craft workforce, new attitudes toward work, diversity of cultures, widening gulf between wealthy and poor
4. Environmental – involving climate change, resource depletion, saturation of natural sinks, decreases in biodiversity, broader awareness of life cycle issues

The external illustrative scenarios depicted in the following chart are broadly classified through socio-political stability vs. instability on the Y axis and poor vs. good economy on the X axis. The internal illustrative scenarios are divided using incremental evolution vs. sharp discontinuity on the Y axis and commodity product or service vs. custom product or service on the X axis. Each scenario is given a fictional name so that it is easily recalled, but these names are not necessarily descriptive of many of the aspects found in each story of the future. To move the scenarios into a workable format for potential decision-making by A/E/C/ firm managers, each external scenario is juxtaposed with each internal scenario in a summary chart and possible firm responses related to inputs, outputs and production logics are proffered.

Please note that the names provided for each scenario (including Clear Sailing, Head Winds, Storm Clouds and Run Aground for Outside-In drivers, and Henry VIII, Joan of Arc, Queen Victoria and King Arthur for Inside-Out Drivers) are fictional and have been chosen as illustrative labels for organizational and summarization purposes to create easy-to-remember exemplars for the combinatorial chart that follows the johari's windows:

Four Scenarios for A/E/C Firms from "Outside In"

	Poor Economy	Good Economy
Socio-Political Stability	*Head Winds* ▪ Lack of credit availability ▪ Low volume of work ▪ New technol costs high ▪ Business confidence low ▪ Demographics flat	*Clear Sailing* ▪ Credit adequate ▪ Work is plentiful ▪ Technology affordable ▪ Capital invest steady ▪ Demographics increase
Socio-Political Instability	*Run Aground* ▪ Business loans unavail ▪ Projects are scarce ▪ Tax system in flux ▪ Government gridlocked ▪ Demographics decline	*Storm Clouds* ▪ Inflation high ▪ Permitting is glacial ▪ Regulation too low/high ▪ Lack of capital investmt ▪ Mistrust of institutions

Figure 27 Four Scenarios for A/E/C Firms from "Outside In"

Four Scenarios for A/E/C Firms from "Inside Out"

	Commodity Product or Service	Custom Product or Service
Sharp Discontinuity	*Henry VIII* • Stock market plummets • Formidable new competi • Natural disasters/terror • Swift climate change • Demand increas/decreas	*Joan of Arc* • Value of assets declines • Shortge of knowl workers • Shifting customer base • Infrastructure destroyed • Taxes doubled
Incremental Evolution	*Queen Victoria* • Customer base evolves • Growth is sluggish • Regional economies • Resources adequate • Stable transactional relationships	*King Arthur* • Gradual social trends • Asset value mostly stable • Predictable customer base • Long-term business relationships

Figure 28 Four Scenarios for A/E/C/ Firms from "Inside Out"

Tables 49 A, B, C and D Combinations of Outside-In and Inside-Out Scenarios

	OUTSIDE-IN SCENARIOS RECOGNIZING EXTERNAL FORCES	INSIDE-OUT SCENARIOS RECOGNIZING INTERNAL FORCES	POSSIBLE FIRM RESPONSES OR ADAPTIONS, through changes to inputs, outputs and production logic using the firm's total resource base
	Head Winds = Socio-Political Stability + Poor Economy	***Queen Victoria*** = Commodity Product or Service + Incremental Evolution	▪ Decrease output ▪ Change output mix ▪ Improve efficiencies ▪ Fine tune production logic ▪ Emphasize specific factor inputs -- financial assets -- physical produced assets -- organizational assets
	Head Winds	***Henry VIII*** = Commodity Product or Service + Sharp Discontinuity	▪ Increase or decrease output ▪ Adjust output mix ▪ Improve efficiencies ▪ Merge or acquire ▪ Emphasize specific factor inputs -- financial assets -- physical produced assets -- organizational assets
	Head Winds	***Joan of Arc*** = Custom Product or Service + Sharp Discontinuity	▪ Explore alternative markets ▪ Modify output mix ▪ Improve production logic efficy ▪ Merge or acquire ▪ Emphasize specific factor inputs -- Competence assets -- Motivational assets -- Organizational assets
	Head Winds	***King Arthur*** = Custom Product or Service + Incremental Evolution	▪ Maintain market share ▪ Adjust output mix ▪ Find production efficiencies ▪ Cultivate existing customers ▪ Emphasize specific factor

			inputs -- Competence assets -- Organizational assets -- Motivation assets

	OUTSIDE-IN SCENARIOS RECOGNIZING EXTERNAL FORCES	INSIDE-OUT SCENARIOS RECOGNIZING INTERNAL FORCES		POSSIBLE FIRM RESPONSES OR ADAPTIONS, through changes to inputs, outputs and production logic using the firm's total resource base
	Storm Clouds = Socio-Political Instability + Good Economy	***Queen Victoria*** = Commodity Product or Service + Incremental Evolution		• Maintain or increase output • Develop new outputs • Look for efficiencies • Compare prodction logic to others • Emphasize specific factor inputs -- financial assets -- physical produced assets -- organizational assets
	Storm Clouds	***Henry VIII*** = Commodity Product or Service + Sharp Discontinuity		• Adjust output to market • Consider alternative outputs • Strive for efficient production • Add more technlgy to production • Emphasize specific factor inputs -- financial assets -- physical produced assets -- organizational assets
	Storm Clouds	***Joan of Arc*** = Custom Product or Service + Sharp Discontinuity		• Modify output to market needs • Look for emerging markets • Cut losing products and services • Automate additional production • Emphasize specific factor inputs -- competence assets -- motivational assets -- organizational assets
	Storm Clouds	***King Arthur*** = Custom Product or Service + Incremental Evolution		• Maintain or increase outputs • Cement relationships w/ customers

				• Seek production efficiencies • Emphasize specific factor inputs -- competence assets -- organizational assets -- motivational assets

	OUTSIDE-IN SCENARIOS RECOGNIZING EXTERNAL FORCES	INSIDE-OUT SCENARIOS RECOGNIZING INTERNAL FORCES		POSSIBLE FIRM RESPONSES OR ADAPTIONS, through changes to inputs, outputs and production logic using the firm's total resource base
	Run Aground = Socio-Political Instability + Poor Economy	***Queen Victoria*** = Commodity Product or Service + Incremental Evolution		○ Pare output ○ Watch aging receivables ○ Seek maximum efficiencies ○ Fine tune production logic ○ Emphasize specific factor inputs -- financial assets -- physical produced assets -- organizational assets
	Run Aground	***Henry VIII*** = Commodity Product or Service + Sharp Discontinuity		○ Reduce output to meet demand ○ Adjust output mix ○ Find additional efficiencies ○ Sell, merge or acquire ○ Emphasize specific factor inputs -- financial assets -- physical produced assets -- organizational assets
	Run Aground	***Joan of Arc*** = Custom Product or Service + Sharp Discontinuity		○ Modify output subj to demand ○ Cut costs as much as possible ○ Sell, merge or acquire ○ Scrutinize production iterations ○ Emphasize specific factor inputs -- competence assets -- motivational assets -- organizational assets
	Run Aground	***King Arthur*** = Custom Product or Service + Incremental Evolution		○ Reduce output subj to demand ○ Modify output mix ○ Unearth alternative markets ○ Make production adjustments ○ Emphasize specific factor

				inputs -- competence assets -- organizational assets -- motivational assets

	OUTSIDE-IN SCENARIOS RECOGNIZING EXTERNAL FORCES	INSIDE-OUT SCENARIOS RECOGNIZING INTERNAL FORCES		POSSIBLE FIRM RESPONSES OR ADAPTIONS, through changes to inputs, outputs and production logic using the firm's total resource base
	Clear Sailing = Socio-Political Stability + Good Economy	***Queen Victoria*** = Commodity Product or Service + Incremental Evolution		➢ Increase outputs ➢ Develop new outputs ➢ Fine tune production logic ➢ Accumulate and deploy assets ➢ Pay atten to specfc asset categories -- financial assets -- physical produced assets -- organizational assets
	Clear Sailing	***Henry VIII*** = Commodity Product or Service + Sharp Discontinuity		➢ Adjust outputs for changed market ➢ Modify output mix ➢ Scrutinize steps in productn logic ➢ Stockpile protective assets ➢ Emphasize specifc asset categories -- financial assets -- physical produced assets -- organizational assets
	Clear Sailing	***Joan of Arc*** = Custom Product or Service + Sharp Discontinuity		➢ Increase or decrease output ➢ Modify output if market requires ➢ Fine tune production approach ➢ Follow resiliency plan ➢ Emphasize specifc asset categories -- competence assets -- motivational assets -- organizational assets
	Clear Sailing	***King Arthur*** = Custom Product or Service + Incremental Evolution		➢ Expand outputs ➢ Slowly develop new outputs ➢ Tweak production logic ➢ Accumulate and deploy assets ➢ Emphasize specifc asset

				categories -- competence assets -- organizational assets -- motivational assets

The foregoing scenarios provide examples of an economic-system-wide approach to scenario planning for firms in Section 9.5, as well as a series of templates for individual firm tangible and intangible asset reporting in Section 9.4. If sample firm #6 from the Delphi survey (that is, the design-build firm of 2000 employees concentrating on green sustainable projects) was used as a test case for scenario planning and the asset reporting templates, the following issues may arise:

- Characteristics of both value chain and value shop companies – The Delphi panel designations of the design-build firm were split between two value logics, and it would be inappropriate to rule out either value logic on this basis Therefore, consideration of multiple scenarios based on combined production logic would be necessary.
- Mixed asset portfolio (emphases on both tangible and intangible asset categories) – Firms that have high emphases on multiple asset categories, particularly if there are high rankings for both tangible and intangible assets such as for the sample design-build firm, may need additional capabilities (experience, education, leadership) for accumulating and managing these mixed asset portfolios.
- Affected by, and potentially more responsive to, A/E/C industry's four paradigmatic drivers of change – As mentioned earlier in Section 9.5, four drivers are identified as a backdrop to possible futures for architectural, engineering and construction firms. Because a design-build firm, particularly one concentrating on sustainable projects, will actively incorporate technological, financial, knowledge-intensive and environmental resources in the conduct of business, this type of entity

may be better positioned for adaptive change than firms that are only tangentially involved in activities that stem from these exogenous forces.

- Bi-Directional Flow of Tangible and Intangible Assets within a Firm that is both a value chain and a value shop – A design-build firm will likely try to assemble sufficient but relatively expensive tangible assets such as physical natural resources and financial resources, and these will be partially deployed at appropriate time periods within the production cycle. At the same time, the design-build firm's value shop activities will require assembly of relatively inexpensive intangible assets to undertake the knowledge intensive and organizational intensive activities of design and administration for the firm. The tangible assets will add significantly to the book value of the firm, while the intangible assets will add almost nothing to the traditional financial balance sheet; yet the deployment of the intangible assets enable the firm to develop the customer's custom solution, where client demand is for not just a product but also for processes leading to functional or performance outcomes.

Hulten points out that assets (both tangible and intangible) are multi-faceted in that they serve not only as an inventory of goods, but also as a means of production (Hulten 2006). His point is that what economists have been calling "intermediate capital – which also may include hard and soft assets – are simply coined as intermediate because of brief accounting periods; that is, if accounting periods were extended through depreciable lives of the asset, all assets become factor inputs. If the accounting period is one week, then a pencil becomes a capital good (Hulten 2006). What Hulten is trying to show is that a stock and flow model that throws off the yoke of strict definitions for capital goods can more readily accommodate capital assembled for wealth and capital assembled for production, as well as helping researchers move away from such rigid models of traditional accounting-recognized (i.e., primarily physical and financial) capital goods and production.

9.5 Implications of the Research -- Discussion

The importance of expertise for competitive advantage has been emphasized by economists and business strategists who have suggested that wealth creation is less dependent on the bureaucratic control of resources than it once was, and more dependent on the exercise of specialist knowledge and competencies and the management of organizational competencies (Blackler 1995). Within the literature on professions, the term “knowledge” and the opportunities it offers to specific occupational groups to organize their knowledge base and protect it through claims of authority is well-documented (Abbott 1988). Knowledge-intensive firms are concentrations of a particular form of divisions of labor as well as systems of persuasion. The knowledge-intensive firms present problems for analysts of organization and management, because power within such firms stems from ability and reputation, and short-term profit is likely to be a mistaken goal for “know-how” companies since what matters is the company’s ability to convince clients of the importance of a long-term relationship (Sveiby and Lloyd 1987).

In *Driven To Lead*, the author proposes and demonstrates that there are four different and even conflicting priorities for top managers that are needed to arrive at effective, productive solutions (Lawrence 2009). A good corporate leader is one who exhibits a balance of the four drives: 1.) to acquire tangible and intangible assets on behalf of the entity; 2.) to defend self or group interests; 3.) to comprehend one’s self and the world; and 4.) to forge lasting bonds with others (Bart 2010). Misguided leaders ignore or suppress one or more of those drives, and the result is an institution that must eventually change or cease to exist because it is out of balance (Lawrence 2009). It is notable that Lawrence’s first leadership and organizational priority is to acquire tangible *and* intangible assets, as an offset for -- and an antidote to -- agency theory, which is tied to rational self-interest in the tradition of Hobbes and Machiavelli (Bart 2010).

Both Lawrence and Becker articulate similar methodologies that account for both tangible and intangible assets (Lawrence 2009, Becker et al 2006). Parallel to that end, the Bureau of Economic Analysis has concluded that macro and micro data integration should be an objective of economic measurement at all levels: firm, industry and aggregate economy (Becker et al 2005). The core problem has been lack of direct measures of detailed asset use within each industry sector (Jorgenson et al 2006). Even if there are asset groups established for all asset categories (as is proposed by this research), there remains the industry classification legacy barrier to overcome. There is -- in principle -- one and only one correct NAICS code for each business establishment. But as noted in earlier research, some businesses exhibit characteristics wherein they could logically fit within either basic industry or service industry (Beard and Chwat 1994, Lawson et al 2006). Eliminating the conflicts [including establishing new NAICS codes where needed] rather than merely understanding the differences between existing codes ought to be the goal (Abraham 2006).

An implicit supposition of the research was that there would be a gulf between asset deployment selection by firms when faced with a stark choice between continuity and longevity of the firm and maximizing short-term profits. In fact, the findings revealed that there was only a slight difference in selection, and that the rank order of asset group choices remained substantially the same, regardless of the strategic goal of management. In addition, there was a general tendency for asset category emphases to track production logic choices regardless of management strategy, whether carried out according to a goal of continuity and longevity or for short term profit maximization, according to the Delphi expert panel. A possible outcome may be that asset category selections by management, whether for continuity and longevity in response to an economic downturn or to take advantage of a strong economy, would be similar, with only a very slight tendency to increase emphases on financial, motivational and organizational assets in response to a weak economy. This outcome could be attributed to the "steady hand" of the experienced A/E/C professionals who participated in the Delphi surveys, or it could be reflective of the fiscal conservatism of the industry based on cautionary management against the backdrop of economic recession.

When reviewed in context of a broader resource pool available to firms, and contrary to arguments made by resource-based theorists, there may not be a single most important determinant to firm success (Collis 1994, Galbreath 2004). Perhaps this avenue is not an outright contradiction of the resource-based theory of the firm, but rather an extension of the earlier work, which would include resources identified in classical economics. The problem with classical economics is that intangible resources are inadequately acknowledged; but the growing fields of evolutionary economics, world systems theory and biophysical economics are likely to have more permeable boundaries that will likely embrace both tangible and intangible asset accounts.

A National Academy of Sciences (NAS) conference was recently convened to focus on intangible assets. Presenters stressed the importance of corporate disclosure -- in order to enable investors and stakeholders to better assess firm health, potential future earnings and risks -- throughout the entire National Research Council workshop (Mackie 2009). Corporate annual reports and responses to federal government production output surveys are two of the most common forms of disclosure, but the former has been viewed as overly sales-oriented and the latter as highly informative, but incomplete (Adina and Ion 2003). Rather than simply listing output on a government survey, attendees at the 2009 NAS conference noted that good management of assets and having accountability for assets can reduce the cost of capital, and the participants noted that government policy could encourage use of common templates [such as provided in this research project] to accumulate the data (Mackie 2009).

Hannes argues that if a material piece of information confers significant comparative benefits when reviewed by corporate insiders and not by shareholders, one cannot count on voluntary mutual disclosure to occur, and mandatory federal intervention may be in order (Hannes 2004). Skinner counters that the case for disclosure of assets is rather weak, and that US policymakers should refrain from expanding reporting, particularly for intangibles (Skinner 2007). The National Academy of Sciences conference noted the Sarbanes-Oxley Act (Public Company Accounting Reform and Investor Protection Act) contains a directive for assessing intangible assets, but regulations are not clear about how to implement any sort of periodic reporting (Mackie 2009). Part of the problem lies with the inability of elected officials and the voting public to recognize market failure, and then to take steps to redress those forces that would augur against market failure. Mandatory disclosure of both tangible and intangible assets held or deployed by the firm would provide a non-punitive means of averting market failure, resulting in increased economic efficiencies, expansion of public goods, decrease in monopolistic practices and lessening of information asymmetry (Vining and Weimer 1988).

At the close of the 2009 NAS Conference focused on intangibles, economist Kenan Jarboe said "If we really believe that people are our most important asset, why in the world is our basic public policy still built around a machine, and not people?" (Mackie 2009). Over the past decade, steps have been taken to ensure relatively accurate production output statistics from both basic and service industries; however, if (as Baruch Lev insists) calculations of factor inputs are not also available, we will be unable to provide true productivity ratios for the nation, or for a company or for an industry. This research is one small and yet incomplete step toward providing a structure wherein this gap in data can be closed. And it is postulated that as long as firms can protect their unique value logic and production processes, disclosure of factor inputs by general asset categories and sub-categories will not compromise firm short-term or long-term performance, while providing transparency to interested stakeholders.

Trends related to intangible assets and intellectual capital reporting stem from frustration with traditional financial reports as delineated in the Jenkins report by AICPA in 1994 and in writings by Steven Wallman, former SEC Chairman in 1996 (AICPA 1994, Wallman 1996). Most of the research concludes that the additional reporting would overcome information asymmetry, which currently favors only insiders with up-to-date and accurate information about company operations and performance. But rather than impose sanctions on firms for not reporting what has heretofore been unavailable or uncollected, it may be more fruitful to show management how knowledge of total assets can provide insights into efficiencies and effectiveness.

There are some difficult issues to be overcome before intangible assets reporting becomes mainstream. First, there is some disquiet among industry groups about the sensitivity of information that may be disclosed, not due to privacy concerns but more due to competitive advantage concerns (Meritum 2002). There are also issues about the costs of disclosure, particularly when some information is expensive to collect, analyze and summarize for wider distribution. Others have warned that, without standardization, the reports will just contribute to information overload (Eccles et al 2001). What remains surprising is the propensity of financial analysts to leaf directly past intellectual capital reporting, since information about the firm's ability to innovate, investment in research and development, and existence of networks and alliances are essential in order to fully understand a company's financial prospects (Nielson and Madson 2007). Another problem with the acceptance of non-financially-based reporting is the long-term horizon of intangible asset accumulation and deployment, which does not match up well with the short-term horizon of income and expense streams. Finally, the lack of a common denominator has been a deterrent for traditional financial personnel, who seem unable or unwilling to calculate except in dollars. This research has proposed using time as a parallel denominator, since hours spent on firm-related activities can usually be converted to financial measures.

Penman has shown a case for having an income statement "perfectly correct" for a deficient balance sheet, since revenue and expense reports show earnings that implicitly acknowledge the value of intangible assets (Penman 2009). In the 1920s, Penman avers, accountants wrote up asset values in balance sheets for perceived value and were accused after the crash of 1929 of putting "water" in the balance sheet (Penman 2009). A stock analyst working during the Depression recommended separating out what is confidently known from mere speculation, and anchoring on what is known; which is to say, accountants must stick to the facts and leave speculation to those who interpret the facts on behalf of serious investors (Graham 1973). Nevertheless, Penman failed to consider what this research has tried to operationalize: a system whereby parallel budgets, income statements and balance sheets are developed that account for tangible and intangible assets separately, but within identical management accounting periods.

A number of researchers have been concerned with the apparent gap between book value of firms and actual market value, and have described the discrepancy in terms of intangible assets that are unreported on firm financial statements (Stewart 1999, Clare and DeTore

2000, Lev 2001, Florida 2002). This metric may have some utility in a growth economy, but less so during a recession. Another firm valuation comparison is the difference between going concern value and liquidation value. Going concern value is dependent on the total panoply of assets available to the firm, including both tangible/corporeal and intangible/volitional assets.

Assets of a going concern would have exchange value (price that would be paid for the asset in an economic transaction) and use value (worth of a product or service due to its general utility, regardless of the price paid by producers or consumers) (Sennett 2006). Liquidation assets are what are left after a firm has ceased to be going concern, which typically are "hard" assets that have exchange value (thus, physical or financial assets) and can be sold at market prices, but can be intellectual property that is legally protected or registered (Reilly and Schweihs 2004). The concept of going concern value recognizes that time, talent, effort, risk and cost of identifying, obtaining and organizing resources into an efficient input mix is an activity that has economic value in the marketplace (Dimbath 1994).

In terms of firm valuation, it is the stark difference between the book value of assets shown on financial balance sheets and the manner in which firm appraisers value going concern assets that reinforce the need for tangible and intangible asset frameworks such as discussed in the body of this research. Going concern value is an extension of the tangible assets and other separately valued intangible assets such as customer or subscriber lists, special processes, recipes or formulas, proprietary software or other assets deployed by the firm (Dimbath 1994). These other critical elements to firm survival are "off balance sheet" even if one were privileged to have current financial reports of a company. According to Kim, it would be easier to rebuild an organization if it lost all of its physical records and systems, than if it had lost all of its employees (Kim 1993). Asset accounting methods and firm appraisal methods that incorporate at least most of a organization's resources would provide more complete empirical evidence of in support of production theory, input-output theory, evolutionary theory and sustainable theory of the firm.

In the next and final chapter, some conclusions are offered and recommendations are provided about a proposed mainstream total asset flow model (e.g., inclusive of inputs, production logic and outputs), along with a brief discussion why this information would be useful to management and other stakeholders.

"You can't truly measure a nation's productivity, or a company's productivity for that matter, without measuring both outputs of production as compared to the tangible and intangible inputs, or factors of production." __ paraphrased from presentation to the National Academy of Sciences by New York University Professor Baruch Lev, 2009

"*Inventions motivated by a desire to serve humankind are less likely to be socially destructive than those motivated by personal enrichment, and patents should be bestowed or withheld with the foregoing caveat in mind*." __ Sismonde di Sismondi, 1815

CHAPTER 10 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

10.1 Summary and Key Findings

This research endeavors to frame a methodology that can be used to categorize firm value strategies (production logic) and choices of factor inputs (tangible and intangible assets) to fuel production cycles. A secondary aim of this research project is to attempt to determine which asset group combinations may combine to produce sustainable outcomes (continuity and longevity) for A/E/C firms. Through the use of newer micro-economic process models, this thesis placed architectural, engineering and construction firms within these value logic models, used survey techniques to validate the models, and then delved into asset group deployment as selected by an expert panel of nationally prominent A/E/C professionals for six specimen firms. Due to the exploratory nature of the enquiry, the firms included in the survey questionnaire were sample, hypothetical and representative companies, not actual firms (although testing of the concepts with actual firms is a reasonable next step for continuation of this line of research).

The resource-based theory of the firm rests partially on the assertion the intangible assets are major determinants of market and financial performance. There are a series of studies that were done prior to the economic recession of 2008 – 2010 that focus on these measurements with the background assumption of an economy in cycles of continued growth, whether robust growth or slow growth, but always in growth mode. In light of the shortcomings of those measurements, this study attempted to weave production logic theory with asset selection and deployment that covered both tangible and intangible assets to provide a more complete and experience-reflective view of firms operating under current conditions. Although the rose-colored glasses of prosperity may have led previous studies down a particular path, this research effort tries to base its suppositions and methods for a range of economic conditions, including prosperous, dismal (negative growth) and some points in between the two extremes. To think of “success” as only states of maximizing profits or gaining market share at the expense of competitors seems dated, especially following a recession where continuity, longevity and sustainability of companies has at least equal importance according to national survey findings (ACEC 2009).

Review of research results in this new light shows that the findings are mixed with regard to the main prescription of resource-based theory, which postulates that intangible resources are the key drivers of firm success. Organizational and competence assets are generally more important determinants of firm continuity or success, but this is far from universal and the rankings are not overwhelming in their rank order; rather, depending on the level of analysis, the intangible asset categories may have a modest edge over tangible assets for deployment by value shop firms, but not necessarily for value chain firms.

More importantly, because the subject firms (and sample firms in the Delphi study) were all architecture, engineering and construction-based firms, it will be difficult to claim that the findings are anything more than from specific industries and therefore any results should be labeled as contextual rather than generic. Nevertheless, the research does begin to discover what could be termed “hierarchies” of asset categories within specific A/E/C industry segments, such as what was presaged by two previous studies (Roos 2005, Galbreath 2004). This leads one to ponder whether resources are more valuable in specific industry sub-sectors, time periods, or markets (such as public or private; buildings or civil infrastructure), which is consistent with the findings of research by Collis (Collis 1994).

It does seem logical that if firms attain a more complete cognizance of their total asset base, they will gain a better understanding of which assets to stockpile and deploy during the conduct of their business. This observation seemed to be accepted by the Delphi expert panel during the succeeding rounds of surveys and responses, as well as according to comments made by two of the panelists who specifically mentioned the broader awareness of assets and asset categories, not only for firm management but for understanding of customer value logics and asset pools.

The traditional construction firm (medium-sized road constructor used as a sample for placement in the appropriate value logic category) was unanimously placed in the value chain classification. Because the operations of this class of firms more closely follows that operations of manufacturing operations (such as would be observed in repetitive road building and construction of tract housing), its categorical asset emphases were monetary and physical produced assets. This expectation of reliance on financial and physical assets was not replicated, however, by the small construction firm specializing in custom light commercial projects. Instead, expert panelists attributed higher emphases to competence assets, followed by financial and motivational assets. Professional bias may have been at play in these selections, since those from the professional design community were not always in agreement with asset category rankings of constructors and design-builders.

The engineering and architecture sample firms were given value logic classification and asset emphases rankings that tracked consistently. Both of the sample professional design firms were deemed to have asset emphases upon the resources within the competence category first, followed by organizational and motivational asset groups. According to the Delphi consensus, these assets are deployed based on value shop production logic. An open ended question in the Delphi survey attempted to ask the question about assets from a "bottom-up" perspective for each of the sample firms. This question resulted in competence assets being the most emphasized of seven categories of assets for the 400 person engineering firm, the 20 person A/E firm and the 20 person light commercial building firm. Financial assets were deemed most important of the seven asset categories for the 200 person road construction firm, according to the results of the open-ended question. For the 4,000 person EPC firm, legal and registrable assets (which is more or less a transitional category between tangible and intangible assets) garnered the highest emphases score. The sixth sample firm – the 2,000 person green design-build firm – was judged by the Delphi panel (during the open-ended question about asset emphases) to have an equal top ranking for motivational and competence assets.

A key finding of the research is the apparent difficulty of the 21 person expert panel (and of this researcher) in classifying EPC and design-build firms according to the parsimonious Stabell-Fjeldstad value logic model (Stabell and Fjeldstad 1998). As shown in Chapter 2, example firms appear to be plentiful for the classifications of value chains, value shops and value networks (see Table 1), and it is conceivable (as is postulated by Roos and Bukh) that every firm can fit [or be shoehorned] into one of these three categories (Roos et al 2005, Bukh et al 1999). Yet, for all of the attractiveness of a parsimonious model, the Delphi panel often deadlocked on their votes of whether EPC and design-build firms were value chain organizations or value shop entities.

This research project, as described earlier, pursued the use of a framework that would look not only at the value logic of firms, but also would develop a model containing aspects of a tangible and intangible asset mix that would be assembled and deployed by those firms. Results of the second aspect of this study were mixed, partially due to the limitations imposed on its scope, but also due to the lack of availability of larger data sets. In the quantitative portion of the mixed methods approach, survey data resulted in a handful of resource pairs that were compared in an effort to find causal outcomes. These pairs were certainly did not represent fully encompassing views of performance outcomes of the firms, and the shortcomings of this approach are duly acknowledged. Neither was this detriment overcome during the qualitative portion of the research, which depended on a panel of national experts to select asset emphases by sample firms from general categories of assets. In retrospect, it would have been helpful to have well-thought-out resource bundles used by actual firms, who contributed survey information into a large data pool. Such a laudable pursuit will have to wait until industry funds such worthy work.

Quantitative results of the study, as delineated in Chapter 7, resulted in mostly inconclusive findings. There are several reasons for these non-definitive outcomes. First, data was gleaned from a third party survey that had a representative pool of firms; however, a combined national survey of the A/E/C industry does not exist. Second, the survey questions in the third-party questionnaire were not conceived in order to provide exacting research comparisons, but were rather created by a volunteer committee to elicit results that could inform management about firm-based issues that occurred in the previous year. Third, the hypothetical asset comparisons from this quantitative source, because of their construction after – rather than before -- the conduct of the survey, were based on core survey questions not sufficiently crafted to generate consistently reliable measures. Nevertheless, the third-party survey sponsor claims that its response rate is among the highest in the industry when compared to similar surveys such as the PSMJ Survey, FMI Survey and the Zweig-White Surveys of firms in the A/E/C industry. After analysis of the third-party survey data, this research continued with a second-phase survey of related questions posed to a Delphi expert panel. The expert panel responded to three rounds of survey questions aimed specifically at the production logic and categorical asset emphases identified in the goals of the research.

The results of Hypotheses H1A through H4D of Phase I of the research methodology were mixed. Firms that developed and implemented long range strategic plans (three to five years was typical) showed a slight tendency toward longer business life than those that only had one year plans or no plans whatsoever. But when testing whether firms were more profitable when they also possessed a long term strategic plan, the findings showed that the hypothesis was not supported. The survey data was also manipulated to see whether firms with greater encouragement for employees to enroll in multi-day continuing education programs each year had higher margins, and this hypothesis was not supported. Similarly, firms providing for higher continuing education hours for their employees did not appear to greater continuity or longevity.

Firms with greater focus on environmentally sustainable practices appear to have greater longevity; that is, the hypothesis was partially supported, but the sample size for this specific question was small and data was provided for only the most recent year (new question in the third party survey). Firms emphasizing interdisciplinary professional practice did not have greater per capita revenue, were the firms shown to have greater continuity and longevity. The penultimate hypothesis stated that firms seeking out and adopting new technologies would have greater pretax net profit financial performance.

The results based on the data collected and analyzed showed the opposite result. A final hypothesis based on quantitative data suggested that firms seeking out and adopting new technologies would have greater continuity and longevity, an outcome of which was supported by the findings.

Some international studies have claimed that intangible capital subgroups are essentially qualitative attributes of the firm and therefore heterogeneous and non-comparable, which is a condition that persists due partially to the lack of standard definitions and frameworks (Hunter et al 2005). It could be inferred that once better understanding of intangible assets is gained and consensus emerges about how to collect data and measure these assets, then firms can use the information for better decision-making in asset accumulation and allocation choices, in spreading knowledge, for spurring innovation, evaluating strategy execution and other managerial purposes. The qualitative results of the study reveal some tendencies and directions for asset categories identified for the research. The tendencies are summarized in the following table:

Table 50 Asset Tendencies and Patterns Based on Value Logic of Firms

VALUE LOGIC	Value Chain	Value Shop	Value Network	Composite – Value Chain Plus Value Shop
ASSETS DEPLOYED THROUGH:	Machines and Tasks	Knowledge and Exploration	Linkages and Connections	Machines & Tasks Plus Knowledge & Exploration
TYPE(S) OF A/E/C FIRMS IN CATEGORY	Traditional Low Bid Construction Firms, such as Road Builders, Production Home Builders	Architectural and Engineering Firms	No clear evidence of applicability	EPC and Design-Build Firms
ASSET GROUPS EMPHASIZED (In Rank Order From	Financial Physical Produced Organizational Motivational Competence	Competence Motivational Organizational Legal & Registrable Financial Physical Produced	N/A	Competence Organizational Motivational Financial Legal & Registrable

Asset Categories Identified In The Research)	Legal or Registrable Physical Natural	Physical Natural		Physical Produced Physical Natural

This research project was not intended to actually valuate intangible assets, but focused on investigating the relative emphasis on asset groups as factor inputs into a firm's production cycle. This is similar to recent research by Lin and Tang, who found that tangible and intangible assets could be sorted in order according to their weighted contributions as value drivers (Lin and Tang 2008). The researchers discovered that genuine intangible asset values may vary among firms, but professionals within the same industry would have a converged idea regarding ways in which the intangible assets would be arrayed based on industry type. The researchers also pointed out that when firms define their organizational self-interest too narrowly, they decrease the long-term value of their business, and when the firm self-interest expands to include satisfaction of customers and employees (not just financial goals of the owners), the result can drive customer loyalty and revenue growth for the firm (Lin and Tang 2008).

Ongoing research in the field has been re-invigorated by the Census Bureau's 2008 decision to – for the first time -- treat R&D expenditures as investment (Aizcorbe et al 2009). Earlier micro-economic literature had not provided much attention to measuring innovation or intangibles and their effects on the economy, in part because the exacting measurement of these activities required one to model processes, linkages and complementarities (Fagerberg 2004). For intangibles, depreciation rates are particularly difficult to measure because depreciation is often linked to obsolescence, which can vary immensely across intangible assets, as opposed to physical wear and tear on tangible assets that is much more easily observed and recorded (Aizcorbe et al 2009).

While this research does not attempt to estimate service lives of intangible assets, which can range from an instant in time to indefinite (the maximum useful life of an intangible asset formerly was 40 years under FASB guidelines, but was changed under Statement No.

42 in 2004), this research does provide a framework for organizing a firm's asset base and for entering asset life estimates for review by management. If the benefits of an asset continue indefinitely, the firm does not need to amortize the value of the asset, since it may continue to have use and value beyond its contract life and therefore would be carried on the firm's balance sheet at higher or lower than its "fair market value" as gleaned from corporate financial records (Mueller 2004). Most traditional financial accountants would be too risk-averse to show these assets on a traditional financial balance sheet. But rather than ignore the existence of key intangible assets, this research demonstrates how intangible assets accounting through parallel reports would provide a more holistic overview of a firm's current condition and its prospects for the future.

10.2 Potential New Policies or Guidelines for Government and Industry (Are the Findings Generalizable?)

Using data comparisons of measured output to labor and capital inputs, the Federal Reserve Board has used the sources-of-growth model since the 1950s to understand Total Factor Productivity or efficiency of output based on production from a given set of inputs (Hulten 2001). But doubts have been raised about the ability of traditional labor and capital inputs to show efficiencies, especially since many service industries showed negative growth trends, but were nevertheless composed of highly innovative and profitable companies. Economist Robert Solow said in 1987, "You see the computer revolution everywhere except in the productivity data" (Solow 1987).

One recent managerial book stands on the premise that traditional tangible assets are becoming increasingly commoditized, and therefore less important or rarely important as sources of competitive advantage, whereas intangible assets can be seen as clear market differentiators for firms (Spitzer 2007). But another publication warns that while the discussion in corporate boardrooms is ongoing, few are going beyond awareness into action; given that 83 percent of the executives surveyed recognized the value of investing in intangible assets, but only 34 percent acted accordingly (Boulton et al 2000). With an asset-centered, value-centered view, managers can treat their businesses as they would a portfolio of investment securities, including acquiring the right mix of assets and disposing of those that are not seen as productive or supporting long-range strategy (Van Alst 2001).

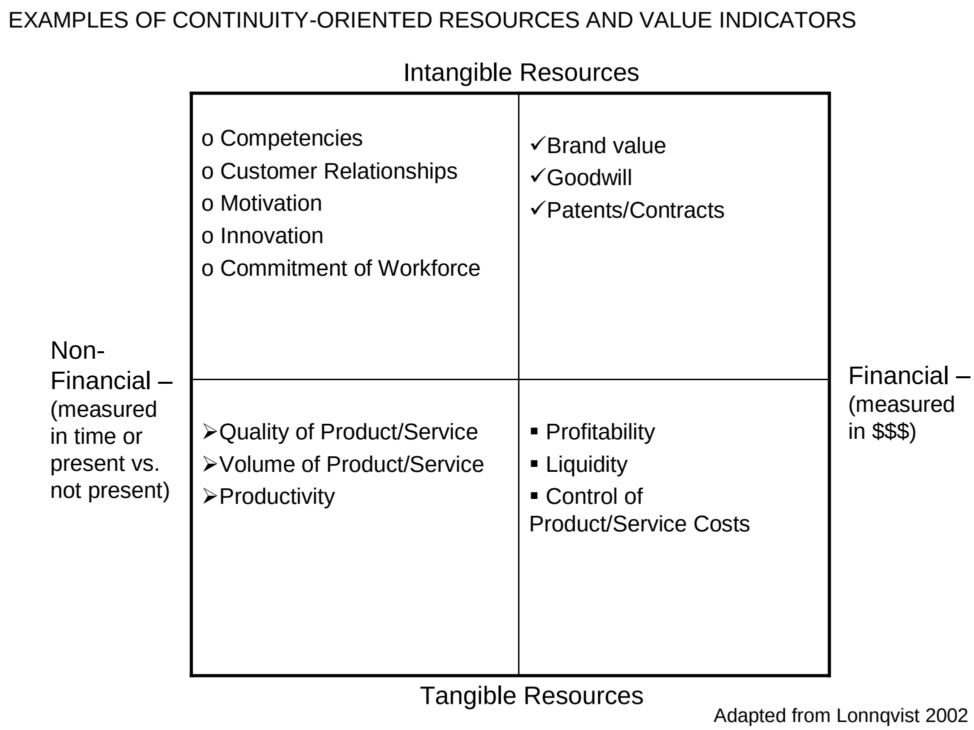


Figure 29 Examples of Continuity-Oriented Resources and Value Indicators Depending on Firm Asset Emphases

As evidenced by recent studies about macroeconomic data describing the economy, the debate over the role of intangible capital in the economy is healthy and appears to be leading to meaningful change. There is a parallel debate in the financial accounting literature as to whether intangibles should be expensed or capitalized. Although the micro-economic objectives may be somewhat different, the principle of data symmetry means that there should be a link between what happens within the broad economy and what happens at the firm level (Corrado et al 2005).

Organizational capital is a major idiosyncratic resource that affects the performance and growth of firms; however, this resource is not measured internally by companies, nor is it reported to capital markets (Lev 2001). In response to this shortcoming, Cornell University economist John Abowd suggests that statisticians need to have a system to build up data from micro-evidence, including human capital (Abowd et al 2005). However, because U.S. government statistical accounts have been developed only to meet specific policy and analytical needs, they are not currently comprehensive or fully integrated (Jorgenson et al 2006). A new organizational structure, one that would link macro accounts to micro accounts, would overcome some of these deficiencies.

10.3 Conclusions

Acquiring and sustaining capital assets is a fundamental task of the firm. These assets are assembled for dual purposes: held for wealth creation or deployed in value-enhancing production processes. Given these economic imperatives, many theories in the academic community have been put forward to explain how firms produce ongoing value and maintain their going concern status within a competitive marketplace. Recently, one of the theories that has gained significant attention is the resource-based theory of the firm, which suggests that strategic assets are largely intangible in nature and can provide differentiation in the marketplace leading to competitive advantage. Similarly, scholars of the New Economy (as opposed to classical or neo-classical economic theorists) have claimed that traditional physical and financial assets are commodities, and available at similar prices to all actors within the economy; and therefore, much greater attention should be given to intangible resources, which are idiosyncratic to the firm.

To test the primary tenet of the resource-based theory and the assumptions of information age economy (i.e., New Economy) scholars, this research established a framework to examine the association between production logic choices and assets of the firm for determining whether these combinations led to firm success, exhibited either by profit maximization or through continuity and longevity of the enterprise. The results suggest that the primary tenet of the resource-based theory – that intangible assets are the only differentiators and that traditional assets are insignificant in terms of competitive resources – cannot be fully supported.

Instead, this research garnered the expertise of seasoned A/E/C practitioners and scholars to ascertain the relative emphases of asset deployment by designating distinct categories of both tangible and intangible assets as more or less important to the firm's production cycle. First, an existing framework for identifying firm value configuration – herein labeled the "Production Logic Framework" – was adopted from the the Stabell – Fjeldstad model and re-affirmed by the Delphi expert panel engaged to participate in the research. Second, a model was constructed as part of this research that served as an asset "periodic chart" depicting all major tangible and intangible asset categories that would reasonably be deployed in the conduct of firm business. This organizational "Total Asset Model" of the firm, when used in conjunction with the Production Logic Framework, provided an overall structure for examining the complex associations between differing production processes and asset deployment by A/E/C firms.

Validation of the asset model was provided by the Delphi expert panel of 21 experts situated in various locations throughout the United States. In the first round of Delphi questioning, these experts were asked to review and comment on the proposed organizational "Total Asset Model" and to provide recommendations for changing its organization or content. The model was confirmed as acceptable for its proposed purposes by 19 of the 21 experts, and two experts suggested minor changes in the sub-content of two separate asset categories. The Delphi process serves as an experiment, according to Sutherland in his essay on Normative System Building, wherein he claims that complex systems require a meta-hypothesis with elements linked together in a consistent system of concepts to form a simplified model that can serve as a surrogate for analysis (Sutherland 2002). The rounds of the Delphi process consist of hypothesis, experimentation, data-gathering, statistical analysis and feedback, representing a series of reasonably-controlled and replicated experiments.

Critics of the Delphi method claim that the process is not based on traditional quantifiable scientific methodologies, and that the experts involved in the Delphi panel may be focused on a sub-system rather than the system, leading to an incomplete and therefore erroneous view of the phenomenon. Similarly, the Delphi method may lead to a very human propensity to discount the future, which may have been exhibited in the successive responses to this research that assigned traditional construction companies to “value chain” production logic categories, while some progressive academic researchers (not involved in this study) have claimed that construction firms are better described as “value shops” in their business approach.

Research outcomes, nevertheless, were bolstered by a high level of agreement among expert panelists, when measured according to “Kendall’s W” coefficient of agreement among anonymous raters of survey questions. Among other statistical analyses, a series of three dozen “radar charts” were compiled, showing categorical asset emphases by six different firm configurations, separated into whether the firm was concentrating on continuity and longevity or short-term profit maximization.

Among the results determined by the study are: 1) traditional construction entities such as road construction firms emphasize physical and financial (tangible) asset groups in the conduct of their business; and 2) for A/E enterprises; architectural design firms emphasize competence and motivation (intangible) assets; and engineering firms emphasize competence and organizational (intangible) assets in the conduct of their businesses. For firms that concentrate on functioning as both the A/E-of-record and the constructor-of-record, including the design-build and EPC firms in the study, competence and organizational (intangible) assets were deemed as more important among the seven asset categories identified in the model (physical natural, physical produced and financial tangible assets; legal and registrable assets, which may be allocated as either tangible or intangible assets, depending on the circumstances; and organizational, competence and motivational [including leadership] assets, which are designated within the meta-category of intangible assets).

Among the benefits of the research are the solidification of a framework within which both tangible and intangible assets (or as more appropriately labeled, corporeal and volitional assets) may be conceptualized and measured for purposes of ongoing and future investigations, and a methodology for benchmarking ongoing investments in a firm’s portfolio of resources. Secondary benefits of the research include the proffering of an employee survey that can be used to formulate a firm statement of activities relating to intangible assets (that is, those activities that would not be shown on the firm's financial income statement), as well as templates for asset inventory summary sheets (with a tabulation column for depreciation) and a culminating template for assemblage of firm-based non-financial reports, including an intangible assets balance sheet. These latter templates are postulates and have not yet been tested. However, they represent fertile ground for future research.

10.4 Suggestions for Further Research

This research proposed a novel framework consisting of 1.) assessment of the value logic of A/E/C firms through a different theoretical lens than has been used in previous research, followed by 2.) categorical analysis of tangible and intangible assets deployment by sample firms. A methodology was employed to systematically ascertain asset emphases by assignation to a spectrum of asset categories, in the interest of seeing patterns and trends that would shed new light on business management issues in the design and construction industry.

An initial follow-up study should be undertaken to survey actual firms rather than sample or hypothetical firms. Use of actual firms and their data responses within an adequate and well-rounded pool would almost certainly improve the granularity of the findings. However, due to the fragmentation of the industry, gaining a sufficient data pool may take time and incentives, since architects, engineers and constructors are represented by numerous organizations, whose sponsorship would significantly help the research response rate. Another critical follow-up study would involve the use of assets accumulated and deployed on projects. Such a study would help answer an industry concern about the asset mix that A/E/C firms bring together on behalf of clients to create additional capital assets (finished commercial and industrial buildings, energy and power facilities, civil infrastructure, etc.).

One of the striking observations of the survey was the consistently low emphasis on physical natural assets, despite the fact the design and construction industry has such an influence on environmental quality. It is this researcher's contention that a new study, examining total assets deployed on behalf of clients' projects, would uncover a substantially higher emphasis on physical natural assets. This is a humbling recognition in that the current study was incomplete in terms of considering only tangible and intangible assets that were accumulated and deployed on behalf of direct business operations, and the methodology omitted the acquisition, handling and fabrication of new capital assets through contracts for others (i.e., design and construction projects), which is the core business of A/E/C firms. It would be important for those firms trying to show their embrace of triple bottom line principles to acknowledge acquisition and deployment of physical natural assets on behalf of facilities and infrastructure owners, once a scheme was established so that these assets were not double-counted in industry-specific or aggregate economy statistics.

More research is also needed on what constitutes a sustainable firm, including from the perspectives of environmental stewardship and enterprise continuity. None of the total asset models published in previous accounting theory and resource-based firm theory research explicitly recognized physical natural assets, nor did these studies subdivide natural resources into non-renewable and renewable resources for purposes of measuring a firm's asset emphases in accumulation or deployment of these resources. While this research project has provided a holistic framework, much additional work needs to be done to account for and accurately measure what had heretofore been treated as economic externalities outside of the sub-system of the firm.

A second view of the sustainable firm is concerned with survival and continuity. A previous preoccupation with studying firms that achieve excess profits seems comparable to a research hospital studying only exceptional athletes. It is likely that more is learned about the human body when medical research studies the average human physique, or even those who are less than average or perhaps injured or ill, than if one focuses only on studying "good to great." Interestingly, nearly half of the firms illustrated in Collins' 2001 book *Good to Great* are no longer in business (Collins 2001). It is time to balance, as Warren Buffett counsels, the exuberance over high-flying companies with a sober look at slow and steady firms that over a ten year period pay modest but steady dividends and are truly in business for the long pull. Research on firms striving to achieve sustainable triple bottom line sustainability through incremental or steady improvement, rather than only through economic excess profits, would seem to be more meaningful to resource-based scholarship than what has been produced thus far.

A contemporary organization, such as an operating firm, is a system that needs to know how to interpret events in order to survive (Daft and Weick 1984). A firm must also integrate transaction, production and governance costs (Williamson 2002). The scenario exercise at the close of Chapter 9 is a way of providing alternative roadmaps for firms concerned with changing events, and it includes plausible responses (related to managerial transaction, production and governance) for uncertain but possible futures. Future research can engage real A/E/C firms to explore alternative scenarios, which are often more effective in broadening perspectives through participation than redacting reports or listening to formal briefings.

An overarching question about this research topic is whether the collection, analyses and reporting of tangible or intangible assets contributes to the greater good, or due to its moving-away-of-the-stage-curtain activity, has a deleterious effect upon the firm's operating latitude, trade secrets and market competitiveness. Future research should look into whether disclosure of factor inputs reveals trade secrets or competitive advantages of subject firms, balanced against
disclosure of factor inputs to improve investor and stakeholder information and represent good public policy through required regulatory disclosures. Even if disclosure and transparency cannot be socially constructed, firms and their managers may discover new paths to efficiency or effectiveness through continuation of similar tangible and intangible asset research.

After the firm-level studies are undertaken, it may be fruitful to develop a pilot project with a prescribed industry sector, and determine if data would mesh appropriately with macro-economic statistics wanted by the Department of Commerce. As Lev admonishes, reporting of intangibles in a subsidiary or satellite account (as recommended by the Bureau of the Census) is like burying the issue (Corrado 2005). Instead, the use of organizational-level surveys can let us know of the existence of assets, and then both debt holder and equity holder valuations can be performed (Brynjolfsson and Hitt 2005). Intangible/volitional assets may be complex, but they are not unobservable or un-countable.

APPENDIX A – DELPHI BACKGROUND, APPROACH AND SURVEY

BACKGROUND

The Delphi technique was devised in the period following World War II to aid the Army Air Corps with forecasting the impact of technology where scientific evidence was scant or non-existent. Shortcomings in traditional forecasting methods, which rely on strong data, quantitative models and trend extrapolation, became apparent in areas where precise scientific laws had not yet established (Rescher 1998). A government contract awarded to Douglas Aircraft Company became "Project RAND" in 1946 wherein experts were asked to give their input on the probability, frequency and intensity of intercontinental ballistic warfare within a process repeated several times to attain a consensus as experts learned (anonymously) from each other's judgments (Linstone and Turoff 1975).

The Delphi method is one of a handful of interesting group techniques, which may be contrasted with individual judgment techniques. Judgment actually is a middle ground state of awareness between *knowledge* and *guess*. A judgment task is defined as having some level of uncertainty with the accuracy of the response, as opposed to a knowledge task, wherein there is perfect certainty about the accuracy of the response, as contrasted with a guess, which is a response with little or no certainty (Sniesek and Henry 1989). Scheele has developed a ranked list of "reality constructions" that depicts a scale of conceptualizations, starting with basic interactions to produce social reality to more intensive group thinking that results from negotiation and interpretation (Scheele 1974). People have highly idiosyncratic ideas and experiences, but the meaning of reality is constructed through interaction with others in various contexts, such as in casual groups, purposive groups or societal agents (Scheele 1974).

General applications of the Delphi method since World War II have been demonstrated by government, business and the non-profit sector (Linstone and Turoff 1975). Uses of groups to generate judgments is a common practice over the second half of the 20th century and into the first decade of the 21st century, as committees, task forces, boards, councils and juries are constituted under the belief that N + 1 heads are better than just one (Hill

1982). A series of studies have shown that group decisions and judgments have an advantage over individual ideas and decisions in a number of different disciplines (Hill 1982; Rowe and Wright 1996). One study concluded that a simple aggregation of individual judgments is more accurate (in nearly all cases) than the judgment of a random individual (Woudenberg 1991).

A significant source for peer-reviewed journal articles addressing issues related to the Delphi method are found in the *Technological Forecasting and Social Change* periodical, published by Elsevier, and through a free compendium entitled *The Delphi Method – Techniques and Applications,* assembled by Prof. Harold Linstone, Portland State University and Prof. Murray Turoff, New Jersey Institute of Technology.

ALTERNATIVE METHODS – GROUP AND INDIVIDUAL

Four of the more common methods for generating group judgments are staticized groups, interacting groups, Nominal Group Technique and Delphi. Before group techniques are summarized in this section, individual judgment is briefly considered.

The phrase "bounded rationality" is attributed to Simon who said that human judgment is limited by available information, available time and the information-processing capability of the human mind. Simon also listed two cognitive styles exhibited by individuals: first, maximizers try to make the optimal decision and satisficers simply try to find a solution that is just "good enough" (Simon 1982). While the two are inextricably linked, there are two distinct steps in the individual judgment process consisting 1) of problem analysis and 2) arriving at a conclusion. Reaction (to current stimuli), assimilation (of new information) and predisposition (existing knowledge) are in play during the cognitive process, and may also be influenced by personal style (Katsenelinoigen 1997). Two primary styles have been documented based on differing approaches to the game of chess: the combinational style is characterized by a narrow, clearly defined, programmatic method that links the initial position with the final outcome; and a positional style that allows one to elaborate on semi-complete linkages when confronted with unknown future, until a program of action emerges (Katsenelinoigen 1997).

Individual critical thinking considers the evidence available, the context of the judgment and the criteria for making a judgment, along with the theoretical constructs for understanding the problem. Glaser said that the ability to think critically involves an attitude of being disposed to consider, in a thoughtful way, subjects and problems; and to apply the methods of logical inquiry and reasoning; and to test assumptions and conclusions to find depth and significance (Glaser 1941). To avoid individual bias, scholars learn the art of suspending judgment to avoid moving too quickly from perception to conclusion, but overcoming personal cognitive bias (such as ignoring pessimistic evidence or relying only on the latest data) is difficult (Chua et al 2004).

A staticized group is usually a fairly simple polling technique in which a number of individuals provide opinions, which are collected separately, and then placed together in a composite summary to for a group decision. Members of the staticized group are drawn from a statistical sample of a target population. However, this method (although widely employed) has been criticized as being more of a determination of popular choice rather than a reasoned interaction among different individuals (Rowe et al 1991). Another common group analysis technique is the interacting group. Use of this method involves bringing people together to form a refined opinion after deliberate discussions (Rowe et al 1991). Participation in a group judgment may have the advantages of increased commitment of individuals, assistance in resolving ambiguous and conflicting knowledge and facilitation of creativity (Lock 1987). Nevertheless, there are concerns about the interacting group technique, such as the individual group member's desire to "win" or to avoid changing an opinion once they have voiced it in front of the group causes the group to perform at a suboptimal level and not up to full potential (Rowe et al 1991). Other detrimental outcomes of interacting groups may include

1.) Groupthink -- where members' access to the same knowledge base results in a restriction on the range of ideas generated by the group, or of the individuals conforming to the group norms;
2.) Inhibition of contributions – caused by differences in the status of individuals in the group, which chills the willingness of some individuals to put forward ideas

contrary to those already established by the group, or that one individual is clearly dominant and this dominance inhibits contributions of ideas and thoughts;

3.) Premature closure – resulting from an tendency to adopt the first alternative, which is reasonably satisfactory to all group members, rather than having the rigor of reaching for the best alternative for the problem at hand (Lock 1987).

An additional structured group technique was developed by Delbecq and Van De Ven in 1968 entitled the Nominal Group Technique (Delbecq et al 1975). Nominal Group Technique consists of individuals seated at a meeting wherein each invited individual writes down ideas related to the problem and then presents one of the ideas to the group. Ideas are recorded and discussion is delayed until all of the ideas are presented. After the ideas are listed, they are discussed one-at-a-time, and each individual writes down evaluations on each ideas. The final stage consists of an aggregation of all of the individual evaluations in order to arrive at a group decision. Nominal Group Technique tries to minimize the negative aspects of the interacting group approach by structuring the processes of independent idea generation, written feedback, recorded evaluations and aggregation of opinions (Lock 1987).

The Delphi technique overcomes some of the criticisms of Nominal Group Technique by reducing the influence of psychological factors of face-to-face meetings such as the unwillingness to abandon publicly expressed opinions and the bandwagon effect of majority opinion (Mulgrave and Ducanis 1975). Through the Delphi procedure, it is possible to obtain the most reliable consensus of opinion of a group of experts through a series of questionnaires interspersed with controlled feedback (Dalkey and Helmer 1963).

There are three important characteristics to a Delphi study:

1.) Anonymity – The identity of participants stays concealed in a Delphi study, mostly eliminating the social pressures that surface in interacting groups.
2.) Iteration with Controlled Feedback – After each survey iteration, members of the Delphi panel can review and change their response based on additional information received from the group.

3.) Statistical Aggregation of Responses – Following the series of survey rounds (usually two or three rounds), the group response is tabulated through statistical aggregation, and statistics may also be used to calculate the level of consensus related to the responses (Rowe and Wright 1996).

THEORY

Dalkey provides some underpinnings for Delphi in his development of "A Theory of Group Estimation" (Dalkey 1969). A Delphi approach relies on expert judgment to arrive at the best information obtainable, similar to using a set of readings taken with an instrument that is subject to random error. Therefore, a statistical measure of central tendency is considered to be the best measure of the quantity, with some measure of dispersion taken to represent a confidence interval about the central value. The resultant geometric mean of the responses is more accurate than the average response; or stated another way, the error of the geometric mean is smaller than the average error. The error of the median is a linear function of the standard deviation and can be shown as a constant (bias = error/standard deviation) to show that, on average, experts perform like biased instruments in these experiments (Dalkey 1969).

The primary reasons for using Delphi include the determination of not only which answers (such as in public policy questions) are most important, but to determine the degree to which each answer (e.g., public policy alternative) is preferred over other answers (alternate policies). However, the use of Delphi for policy questions would be labeled as a debate over unstructured issues, such as in a Hegelian inquiry system (Mitroff and Turoff 1975). Underlying any scientific theory or hypothesis is a philosophical basis, or philosophical bases, upon which one can confidently say that such a methodology leads to true and accurate understanding. Mitroff and Turoff summarize five key inquiry systems that can be used as philosophical bases for the Delphi technique:

1.) Leibnizian Inquiry System – A Leibnizian analyst would ask how could one independently of any empirical or personal considerations provide a purely rational justification for the proposed proposition? The truth of the model is measured in terms of its ability to offer a theoretical explanation of a wide range of phenomena, and the analyst's ability to state clearly the formal conditions under which the model exists. In this system, truth is *analytic*.

2.) Lockean Inquiry System – A Lockean analyst would ask for supporting statistics and probabilities in advance of development of formal theory. The truth of the model would be measured in terms of its ability to reduce complex propositions down to simple referents, and ensure the validity of those referents by means of widespread agreement between different observers. In the Lockean system, truth is e*xperimental*.
3.) Kantian Inquiry System – A Kantian analyst would inquire whether there is a stronger combination of data and theory (models) that exists side-by-side to better justify the propositions? In the Kantian view, truth has both empirical and theoretical natures. Truth of a model is measured in terms of the model's ability to associate each theoretical aspect of the model with some empirical referent and to show how underlying every empirical observation is a theoretical antecedent. For a Kantian inquiry, truth is *synthetic*; that is, reliant on both theory and data, and is the system that can generate alternative models in lieu of a single "best" model.
4.) Hegelian Inquiry System – Hegelian analysts ask whether there may be an alternate world-view that would permit an opposite set of propositions? Could this alternative view be more true or more desirable, or could the counter-plan allow a creative synthesis to emerge from the original plan and the counter-plan? Truth is the result of an unremitting debate over the whole system, in which the dialectical approach tries to reconcile the plan and the counterplan. In the Hegelian system, truth is *conflictual*.
5.) Singerian Inquiry System – A Singerian analyst may ask whether researchers have taken a broad enough perspective of the basic problem? From the beginning, has the right question been asked, and the correct objectives considered? For the Singerian, truth is relative to the overall goals and objectives of the inquiry, and is measured with respect to its ability to define certain objectives and propose alternative means for securing those objectives and by specifying new goals to be

accomplished by future inquiries. In the Singerian system, truth is *pragmatic*. (Mitroff and Turoff 1975).

The Delphi technique represents a prime example of Lockean inquiry, in which the purpose is to gain consensus from experts on important questions (Parente 1987). However, for policy questions, where experts would debate over unstructured issues, the Hegelian inquiry system may be the appropriate foundation. And for eliciting alternatives, a Kantian inquiry may be more appropriate and the Delphi model structured to achieve those ends. For researchers exploring problems, knowledge of the basis of inquiry to be employed with the research methodology is vital, because it helps to define both the possibilities and boundaries of the study, as well as the potentialities and limitations of the variant of Delphi chosen for the study.

DETAILS OF THE DELPHI APPROACH

Sutherland suggests using a method which is "Janus-faced" with one face turned toward imagination, evaluation and axiological inputs, while the other scans the empirical domain for relevant facts (Sutherland 1973). Of the well-used research methods, the Delphi technique attempts to reconcile the "now" and the "next" of the guardian god of doors and beginnings. Policy research methods predicated on extrapolation, historical projection or analogy-building may restrict the results of the analysis by the instruments of the analysis. A rationale for the Delphi process serving as an experiment is also provided by Sutherland in his essay on Normative System Building, wherein he claims that complex systems require a meta-hypothesis, with elements linked together in a consistent system of concepts to form a simplified network model that can serve as surrogate for analysis. The result of the Delphi hypothesis – experimentation – feedback process is a reasonably well-controlled experiment (Sutherland 2002).

Herbert Simon recognized "expertise" as a possible basis of authority for fact-finding and projections (Simon 1958). In an examination of thinking abilities of experts, researchers have claimed that people not only acquire content knowledge as the practice cognitive skills in a particular discipline, but they also develop mechanisms to use large and familiar knowledge bases efficiently (Ericsson and Staszewski 1989). The systematic reliance on an independent panel of experts in a structured process is believed to have certain advantages over individual judgments, especially in areas where there is a dearth of quantitative research (Rowe and Wright 1996). Experts have been defined as a group of informed individuals who are specialists in their respective fields (Goodman 1987).

The statements that comprise the elements of a Delphi exercise may reflect the cultural attitudes and subjective knowledge of the person that formulates them. There is a relationship between the number of words and the amount of information obtained: low and high numbers of words yield low consensus with medium statements (or survey questions) yielding the highest consensus (Linstone and Turoff 1975). One study concluded that 20 to 25 words per variable formed the peak in the distribution (Salancik 1973). Experts come to a very high consensus with moderate statement lengths but fall to a low level of agreement with long statements…apparently, the addition of words brings an effect similar to that of disputations by Talmudic scholars about minutae (Linestone and Turoff 1975).

The number of Delphi rounds that are necessary to provide an effective outcome has also been of interest to researchers. According to Brockhoff, variance reduction usually occurs between the first and the fifth rounds, but the test results are almost always known in the third round and additional rounds may actually impair the results (Brockhoff 1973). The size of an expert panel for a Delphi study is not an established norm, but varies according to the availability of identified experts and the nature of the research study. A review of two dozen studies abstracted through online sources such as ProQuest and EBSCOHost revealed panels ranging from 5 persons to 100 persons. Many studies use between 15 and 35 panelists (Gordon 1994). However, Brockhoff concluded from his series of Delphi studies that a general positive relationship between group size and group performance could not be recognized (Brockhoff 1973).

CRITICISM OF THE DELPHI METHOD

Because of their mathematical nature, most quantitative simulation models suffer from a variety of problems: they tend to be excessively numerical, concentrating on variables that can be readily quantified, and tend to exclude variables that may be important but are more subjective in nature (Kane 1972). But others caution that the Delphi method may be better suited to longer range scenarios than short term forecasting because of the increased errors resulting from the propensity to tie answers to the status quo (Brockhoff 1973).

The most extensive criticism of the Delphi technique was penned by Sackman, who challenged the method on the grounds that it was not based on traditional quantifiable scientific methodologies (Sackman 1974). But Coates conceded that, where complex problems exist for which there are no adequate models, then the Delphi method may be the research approach of last resort (Coates 1975). Among the potential detriments to using Delphi is the very human propensity to discount the future, in that most people are only concerned about their immediate neighborhood in space and time, and most individuals have a very short planning horizon (Linstone 2002). Further, the degree of discounting the future may vary with the person's social status and education; for example, people at the bottom of A. H. Maslow's hierarchy will discount environmental pollution as an important issue much more heavily than those at the top (Linstone 2002).

A parallel worry about the Delphi system is the reliance on specialists who may be focused on a sub-system rather than the system, such as aircraft experts from the Army Air Force in the Second World War predicting that long range bombers would be standard for the next 50 years, and not anticipating intercontinental ballistic missiles (Moynihan 1968). A dogmatic drive for conformity, or the tyranny of the majority, sometimes threatens to swamp the single maverick who may actually have better insight than the rest of the experts (Linstone 2002).

Applications of the Delphi method have increased in both the traditional science and social science domains, and a number of studies have been completed to test the validity of the technique. Among the shortcomings of Delphi recognized in those works are:

1.) Value of Anonymity – Insistence in anonymity will lead to lack of accountability and can encourage ill-considered answers to problems that are posed to experts (Goodman 1987). Further, without the opportunity to converse with one another prevents meaningful discussions that could provide more flexibility and richness to problem exploration and problem-solving (Woudenberg 1991).
2.) Question of Accuracy – Delphi studies are often focused on issues that have not been widely researched, and because the outcomes are about events in the future, the accuracy of Delphi-dependent studies are difficult to measure, although content validity (based on participation of experts) could be assumed (Goodman 1987).
3.) Reliability of Delphi – Perhaps the harshest criticism of Delphi has been the assertion that there are no guarantees that the same Delphi result would be obtained if the study were repeated with another expert panel (Keeney et al 2001).
4.) Forced or False Consensus – Some studies suggest that consensus gained over several rounds may be the result of expert panelists simply altering their estimates in order to conform to the group, without actually changing their personal opinion (Woudenberg 1991). In addition, social pressures (such as a dominant individual) are still felt even though they are not as threatening or immediate as in an unstructured group (Rowe et al 1991).

In sum, Delphi is not a method that can challenge model-based or statistical research approaches, but it can be used in judgment or forecasting studies in which pure scientific methods based on hard data and clear statistics may not be practical (Rowe and Wright 1999). Delphi is a useful technique with a mixed track record, which may be partially attributed to poor application and also due to incomplete understanding of the topic by participants (Rescher 1998).

APPLICATION OF DELPHI TO THIS RESEARCH PROJECT

The Delphi method has been chosen for aspects of this research project due to its process for engaging a panel of experts to examine a sector of the financial system within a larger system, and to elicit a level of consensus among the group about the issues posed in the Delphi survey. The technique also minimizes the difficulties that would be confronted if one were to have face-to-face meetings due to geographical distances, limited time and unavailability of resources for travel.

Dalkey recommends two ways of improving the accuracy of a Delphi study – include at least two iterations of responses and select a more expert subgroup (Dalkey 1970). Both of his recommendations were incorporated in the development of the Delphi process, by scheduling three iterations and by finding industry experts with at least 20 years of professional experience in at least one of the four primary disciplines in the design and construction industry. Components of the Delphi procedure selected for this research are outlined and explained in the following section:

Structured Delphi – Many conventional Delphi studies begin with the first iteration containing an unstructured section, wherein the participants are encouraged to identify and elaborate on those issues they consider important (Rowe and Wright 1999). Recently however, more Delphi studies have included structured first iterations, in which an inventory is provided to clarify the process and to save time in focusing in on key questions (Woudenberg 1991). Because a structured Delphi may introduce some facilitator bias through information provided in the first round, care must be taken to construct realistic and fair scenarios for assessment (Keeny et al 2001).

Number of Iterations – Most of the change in an expert panels' responses occurs after one or two iterations (Rowe and Wright 1999). Woudenberg says that consensus is maximized after the second round, and quality of responses may increase in the third iteration (Woudenberg 1991). Because of the increasing demands for time brought on by successive later rounds, there is a high incidence of drop-out (withdrawal from participation in the study) by experts in later rounds (McKenna 1994).   Based on recommendations of Rowe and Wright (1999), this research study will rely on three iterations, both to gain better results by the third estimation round and to retain as many participants from the outset through the three rounds as possible.

Expert Panel Size – Delphi panels have ranged from 5 to 100 persons, but most have incorporated 10 to 35 participants (Gordon 1994). Brockhoff tested the impact of the number of panelists with five, seven, nine and 11 persons, and did not find any difference in effectiveness based on the size of the expert panel (Brockhoff 1975). Hogarth found that expert groups composed of a minimum of eight to 12 panelists reached maximum validity (Hogarth 1978). The research study being undertaken herein anticipates starting with 25 experts, with the realization that there may be some attrition after two or three rounds, reducing the pool of experts on the panel to approximately 15 to 20 persons who will contribute meaningful data.

Expert Panel Selection – Selection of panel members is central to the success of the Delphi method (Robinson 1991). Following the statement by Goodman (1987) that experts are defined as a group of informed individuals who are specialists in their respective fields, this research study was dependent upon the recruitment of a group of design and construction experts across the United States who each have at least 20 years of management experience in architecture, engineering and/or construction. This expertise represents knowledge authority that is used as a basis for fact-finding and projections (Simon 1959).

Subgroups and Indicators – Among the expert panel subgroups identified for the study are professions represented by the A/E/C industry, which include architects, engineers, constructors and design-builders or EPC (Engineer – Procure – Construct) managers. The latter expert panel subgroup can be combined into a single integrated delivery category. The indicators used for firms are based on the Stabell-Fjeldstad production logic types, including firms that are value chains, value shops or value networks. Performance indicators are used to describe the range of emphasis among seven categories of tangible and intangible assets, including low, medium or high emphasis (for firm continuity) for each of the seven categories.

Survey Information and Questions – At the end of this section, please find a facsimile of the actual invitation and consent letter to expert panelists, as well as Survey questionnaires for rounds one, two and three of the research project.

Feedback from Each Iteration – It is generally accepted that a Delphi study provides richer data when multiple iterations are used and there are response revisions due to the feedback (Rowe et al 1991). In a study that compared whether iteration, statistical or reasons feedback were more influential, it was found that survey participants, when provided with "reasons" feedback, would change their responses in a way that led to reduction of error, but at the same time, would be less likely (as a group) to change their responses in the first place (Rowe and Wright 1996). Another study found similar results in that when Delphi groups were given "reasons" feedback, in a addition to median and range of estimates, the data and results were more accurate than with Delphi groups that excluded reasons (Best 1974). As a result of these tests of the Delphi method, it appears that iterations allowing participants to reflect on their previous responses, as well as feedback providing both statistical and interpretive information, improves the results of Delphi studies.

Aggregation of Responses – After the third iteration, a compilation of responses will be calculated using traditional statistical aggregation methods, such as the mean and median of the composite responses (Gordon 1994). Use of the mean and median provides equal weight to each of the responses. Others have argued that individual responses should be given their own weight, with differential weighting based on accuracy of responses or self-evaluations (Lock 1987). Equal weighting avoids arguments over differential weighting and if all Delphi participants have positive validity and reasonably similar variability, equal weighting should work adequately (Ashton and Ashton 1985). Kendall's *Coefficient of Concordance* (*W*) is commonly used in Delphi studies and is regarded as a relative coefficient of agreement among raters (Chan et al 2001). The Kendall's W coefficient has a range of zero (0) to one (1) with zero (0) indicating complete disagreement and one (1) indicating complete agreement among experts. For non-parametric rankings, this measure has been used as an indicator of strength of agreement among Dephi panel experts (Siegel and Catallan 1988).

Kendall's W and Significance – The value of Kendall's coefficient ranges from zero to one, with one indicating complete expert panel agreement and zero indicating complete disagreement. Kendall provides a table for critical coefficient "W" values based on k (number of panelists who are ranking their answers and "N" (number of ranked objects) (Kendall 1970). As an example, within the following table, if 6 rankers (k = 6) [in this case, members of the Delphi panel] ranked 6 objects (N = 6) and their agreement was W = .25, the table would indicate that the value of W was not significant at the a = .05 level. For concordance to be significant at the a = .05 level, the observed W should be .351 or greater.

The Kendall's W coefficient of concordance table is reproduced below:

Table 51 Kendall's W Coefficient of Concordance Table
Kendall's W Values Based on Different Values for k (Number of Raters) and N (Number of Objects) (Kendall 1970)

	N = 4			**N = 5**			**N = 6**			**N = 7**	
K *a*	**.05**	**.01**		**.05**	**.01**		**.05**	**.01**		**.05**	**.01**
3	--	--		.716	.840		.660	.780		.624	.737
4	.619	.768		.552	.683		.512	.629		.484	.592
5	.501	.644		.449	.571		.417	.524		.395	.491
6	.421	.533		.378	.489		.351	.488		.333	.419
8	.318	.429		.287	.379		.267	.347		.253	.324
10	.256	.351		.231	.309		.215	.282		.204	.263
15	.171	.240		.155	.211		.145	.193		.137	.179
20	.129	.182		.117	.160		.109	.146		.103	.136

Delphi Questionnaire # 1 for Expert Panel

Two charts are appended to this survey questionnaire outline to provide information related to the research project in tabular form:

- *Organizational Total Asset Account Spreadsheet* – which contains seven asset categories and typical assets found under each category, and
- *Production Value Logic Chart* – which depicts a way of looking at the production logic of classes of firms, with various firm attributes assigned to each of the three production logic genres.

In addition to the chart, a journal article explaining the Stabell-Fjeldstad value logic theory is attached as optional background reading.

Part 1A – The initial Survey Questionnaire aims to validate the proposed asset categories and subgroups as listed on the *Organizational Total Asset Account* spreadsheet.

Please answer the following questions:

1. Are the asset categories and subgroups understandable?
2. Are the asset categories plausible?
3. Are the asset categories and subgroups relatively comprehensive?
4. Do you think that the assets, as listed in the chart, are measurable, either in dollars or time (hours or days), or would you recommend accounting for the assets through another method?
5. Please assess which asset categories are more/less important (L = Low Importance; M = Medium Importance; H = High Importance) to your professional perspective (select one perspective from four expertise groups of the Delphi expert panel: Architect, Engineer, Constructor, or Designer-Builder/EPC) and place your answers in the "Your Firm" chart.

Seven asset categories from the *Organizational Total Asset Account* chart

Architectural, Engineering, Construction or D-B/EPC Perspective? [please indicate one based on your firm/your profession]	*Physical Natural: Low, Medium or High Emphasis?*	*Physical Produced Low, Medium or High Emphasis?*	*Financial Low, Medium or High Emphasis?*	*Legal or Registrable Low, Medium or High Emphasis?*	*Organizational Low, Medium or High Emphasis?*	*Competence Low, Medium or High Emphasis?*	*Motivation Low, Medium or High Emphasis?*

Part 1B – Use the *Production Value Logic Chart* to categorize the firms shown into one of three value logic types (Value Chain, Value Shop, Value Network). Read the article by Stabell and Fjeldstad to provide a background to value logic theory and organization. Then, fill in the remaining blank cells to the right to show the asset group emphasis (i.e., low, medium or high asset emphasis for going concern value of the firm) in each of the seven asset group categories for each of the following types of firms:

A. Engineering Firm (400 employees) Specializing in Infrastructure Projects
B. EPC Firm (4,000 employees) Specializing in Industrial Projects
C. A/E Firm (20 employees) Specializing in Institutional Buildings
D. Construction Firm (200 employees) Specializing in Road Construction and Paving Contracts
E. Construction Firm (20 employees) Specializing in Light Commercial Building Construction
F. Design-Build Firm (2,000 employees) Specializing in "Green and Sustainable" Commercial and Institutional Facilities

Once the single type of production logic is chosen for the firm (see charts), then fill in the cell under each asset category with a low (L), medium (M) or high (H). Select the L, M or H based on assets that are needed to maintain going concern value of the firm.

EXPECTED RELIANCE OF FIRMS ON SPECIFIC ASSET GROUPS TO SUSTAIN THE VALUE OF THE FIRM OVER TIME (GOING CONCERN VALUE) –

[Instructions: Identify whether the firm is a value chain, value shop or value network in the first cell using the Value Logic Chart; then place a Low (L), Medium (H) and High (H) in each of the remaining cells based on the firm's emphasis on the categories of assets needed to maintain its going concern value. Continue filling in all cells for Firms A through F in the same manner.]

A. Engineering Firm (400 employees) Specializing in Infrastructure Projects.

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registr*	*Organizat*	*Competence*	*Motivation*

B. EPC Firm (4,000 employees) Specializing in Industrial Projects

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizat*	*Competence*	*Motivation*

C. A/E Firm (20 employees) Specializing in Institutional Buildings

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizat*	*Competence*	*Motivation*

D. Construction Firm (200 employees) Specializing in Road Construction and Paving Contracts

Value Chain, Value Shop, or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizat*	*Competence*	*Motivation*

E. Construction Firm (20 employees) Specializing in Light Commercial Building Construction

Value Chain, Value Shop, or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizat*	*Competence*	*Motivation*

F. Design-Build Firm (2,000 employees) Specializing in "Green and Sustainable" Commercial and Institutional Facilities

Value Chain, Value Shop, or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizat*	*Competence*	*Motivation*

Thank you for your participation! **Please e-mail your filled-out questionnaire form to XXXXXX on or before XXX XX, 2010**. If you have any questions about the survey questionnaire or other issues related to this research project, please call me directly at XXX XXX-XXXX..

The Delphi method used for this research project contains two additional questionnaires on the same subject. Questionnaires # 2 and # 3 will be sent to you with composite results of Survey # 1 and Survey # 2, and these responses will be needed on XXX XX, 2010 and XXX X, 2010, respectively. Since each round in intended to inform the panelists of the distribution of responses from other experts, it is important to respond all three related questionnaires to arrive at a Delphi "consensus."

Your time and expertise are much appreciated in the completion of this research project.

Delphi Questionnaire # 2 EX for Expert Panel

Three documents are appended to the Survey #2 questionnaire to provide information related to the research project in tabular form:

- *Organizational Total Asset Account Spreadsheet* – which contains seven asset categories and typical assets found under each category,
- *Production Value Logic Chart* – which depicts a way of looking at the production logic of classes of firms, with various firm attributes assigned to each of the three production logic genres, and
- *Feedback* – Summary scores from expert panel responses to Survey # 1, including median, mean/average and standard deviation tabulations, as well as narrative commentary related to the statistics. [Please note that I have converted the L (low) score to 1, M (medium) to 3, and H (high) to 5, to represent a range found on a typical Likert scale].

Part 2A – Using statistical feedback from Survey # 1 as provided by the researcher, re-score the production logic choices (VC, VS or VN) for each of the six firms and re-score asset emphases for the six types of firms (assume a typical firm of this type) based on the composite findings (Part 2A of this Questionnaire) on a scale of 1 to 5, with 1 = low reliance, 2 = low-to-medium reliance, 3 = medium reliance, 4 = medium-to-high reliance, and 5 = high reliance on a category of assets.

YOUR JUDGMENT IS SOUGHT REGARDING: WHAT IS THE RELIANCE OF THE EXAMPLE FIRMS UPON SPECIFIC ASSET GROUPS FOR CONTINUITY AND LONGEVITY OF THE FIRM (e.g., *which assets should be accumulated and deployed for long term survival of the firm*) –

[Instructions: Identify whether the firm is a value chain, value shop or value network in the first cell using the Value Logic Chart; then place a 1, 2, 3, 4 or 5 (1 = low, 3 = medium, 5 = high) in each of the remaining cells based on the firm's emphasis on the categories of assets needed for continuity and longevity. Continue filling in all cells for Firms A through F in the same manner, assuming a typical firm of each type. Use the entire range for your answers – for example, a sitework construction firm that uses mostly unskilled labor may score low (1) in reliance on competence assets and high (5) in reliance on physical produced assets; and conversely, a small structural engineering firm may score low (1) for reliance on physical produced assets, but high (5) for reliance on competence assets]]

A. Engineering Firm (400 employees) Specializing in Infrastructure Projects.
(On what asset groups would this typical 400 person engineering firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

B. EPC Firm (4,000 employees) Specializing in Industrial Projects
(On what asset groups would this typical 4,000 person engineer-procure-construct firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrabl*	*Organizational*	*Competence*	*Motivation*

C. A/E Firm (20 employees) Specializing in Institutional Buildings
(On what asset groups would this typical 20 person architect/engineer firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizational*	*Competence*	*Motivation*

D. Construction Firm (200 employees) Specializing in Road Construction & Paving
(On what asset groups would this typical 200 person construction firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organization*	*Competence*	*Motivation*

E. Construction Firm (20 employees) Specializing in Light Commercial Building
(On what asset groups would this typical 20 person construction firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizational*	*Competence*	*Motivation*

F. Design-Build Firm (2,000 employees) Specializing in "Green and Sustainable" Commercial and Institutional Facilities
(On what asset groups would this typical 2.,000 person design-build firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organizational*	*Competence*	*Motivation*

Part 2B -- After the six types of firms are re-scored, list two individual assets (using the examples of individual tangible and intangible assets listed on the Organizational Total Asset Account spreadsheet) that would be of greatest importance to each of the six types of firms (Part 2B of this Questionnaire).

Note: You will find *individual* types of assets listed under each asset category on the proposed *Organizational Total Asset Account* spreadsheet.

Based on your overall asset category scoring, what individual assets may be important to the following types of firms? (Please select individual assets from those listed under the overall asset categories on the *Organizational Total Asset Account* spreadsheet)

	400 Person Engineering Firm	4,000 Person EPC Firm	20 Person A/E Firm	200 Person Road Construction Firm	20 Person Light Commercial Building Firm	2,000 Person "Green" Design-Build Firm
Individual						

Asset "A"						
Individual Asset "B"						

Part 2C – Now re-score the firm's emphasis on asset categories based on what would be accumulated and deployed to *maximize profit for the next quarter*.

YOUR JUDGMENT IS SOUGHT REGARDING: WHAT IS THE RELIANCE OF THE EXAMPLE FIRMS UPON SPECIFIC ASSET CATEGORIES FOR PROFIT MAXIMIZATION DURING THE NEXT QUARTER. (e.g., *what is the relative emphasis on assets that should be accumulated and deployed by a typical firm of this type to maximize short-term profits*).

Instructions: Place a 1, 2, 3, 4 or 5 in each of the cells below each type of firm (assume a typical firm of each type) indicating 1 = low reliance, 3 = medium reliance, and 5 = high reliance on these categories of assets for profit maximization in the next quarter. *Please use the entire range for your answers – for example, a sitework construction firm that uses mostly unskilled labor may score low (1) for reliance on competence assets and high (5) for reliance on physical produced assets; and conversely, a small structural engineering firm may score low (1) for reliance on physical produced assets, but high (5) for reliance on competence assets*

G. Engineering Firm (400 employees) Specializing in Infrastructure Projects.
(On what asset groups would this typical 400 person engineering firm rely for profit maximization in the next quarter?)

Value Chain Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organization*	*Competence*	*Motivation*

H. EPC Firm (4,000 employees) Specializing in Industrial Projects
(On what asset groups would this typical 4,000 person engineering firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

I. A/E Firm (20 employees) Specializing in Institutional Buildings
(On what asset groups would this typical 20 person architect/engineer firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registr*	*Organization*	*Competence*	*Motivation*

J. Construction Firm (200 employees) Specializing in Road Construction and Paving Contracts
(On what asset groups would this typical 200 person construction firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

K. Construction Firm (20 employees) Specializing in Light Commercial Building Construction
(On what asset groups would this typical 20 person construction firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

L. Design-Build Firm (2,000 employees) Specializing in “Green and Sustainable” Commercial and Institutional Facilities
(On what asset groups would this typical 400 person engineering firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

Thank you for your participation! **Please e-mail your filled-out questionnaire form to XXXXXXX on or before XXX XX, 2010**. If you have any questions about the survey questionnaire or other issues related to this research project, please call me direct at (XXX) XXX-XXXX.

Delphi Questionnaire # 3 EXP Final for Expert Panel
(Please respond by July XX, 2XXX)

Please note: this is the final questionnaire of the series. For your guidance, three documents are appended to the Survey #3 EXP Final questionnaire to provide information related to the research project in tabular form:

- *Organizational Total Asset Account Spreadsheet* – which contains seven asset categories and typical assets found under each category,
- *Production Value Logic Chart* – which depicts a way of looking at the production logic of classes of firms, with various firm attributes assigned to each of the three production logic genres, and
- *Feedback* – Summary scores from expert panel responses to Survey # 2 EX, including median, mean/average and standard deviation tabulations, as well as narrative commentary related to the statistics.

Part 3A – Using statistical feedback from Survey # 2 EX as provided by the researcher, you may wish to re-score the production logic choices (VC, VS or VN) for each of the six firms and re-score asset emphases for the six types of firms (assume a typical firm of this type) based on the composite findings (please see attached summary) on a scale of 1 to 5, with 1 = low reliance, 2 = low-to-medium reliance, 3 = medium reliance, 4 = medium-to-high reliance, and 5 = high reliance on a category of assets.

Special Note: If you believe that your Part 3A scoring is unchanged from your response to previous Questionnaire # 2 EX, please indicate "Same as Questionnaire # 2 EX" on Part 3A of this form and go to Part 3B.

[Instructions: Identify whether the firm is a value chain, value shop or value network in the first cell using the Value Logic Chart; then place a 1, 2, 3, 4 or 5 (1 = low, 3 = medium, 5 = high) in each of the remaining cells based on the firm's emphasis on the categories of assets needed for continuity and longevity. Continue filling in all cells for Firms A through F in the same manner, assuming a typical firm of each type. Use the entire range for your answers – for example, a sitework construction firm that uses mostly unskilled labor may score low (1) in reliance on competence assets and high (5) in reliance on physical produced assets; and conversely, a small structural engineering firm may score low (1) for reliance on physical produced assets, but high (5) for reliance on competence assets]]

YOUR JUDGMENT IS SOUGHT REGARDING: WHAT IS THE RELIANCE OF THE EXAMPLE FIRMS UPON SPECIFIC ASSET GROUPS FOR CONTINUITY AND LONGEVITY OF THE FIRM (e.g., *which assets should be accumulated and deployed for long term survival of the firm*) –

M. Engineering Firm (400 employees) Specializing in Infrastructure Projects. (On what asset groups would this typical 400 person engineering firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

N. EPC Firm (4,000 employees) Specializing in Industrial Projects
(On what asset groups would this typical 4,000 person engineer-procure-construct firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop, or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

O. A/E Firm (20 employees) Specializing in Institutional Buildings
(On what asset groups would this typical 20 person architect/engineer firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

P. Construction Firm (200 employees) Specializing in Road Construction and Paving Contracts
(On what asset groups would this typical 200 person construction firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

Q. Construction Firm (20 employees) Specializing in Light Commercial Building Construction

(On what asset groups would this typical 20 person construction firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

R. Design-Build Firm (2,000 employees) Specializing in "Green and Sustainable" Commercial and Institutional Facilities

(On what asset groups would this typical 2.,000 person design-build firm rely for continuity and longevity of the firm?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

Part 3B -- After reviewing the attached composite scores/feedback, you may wish to change your listing of two individual assets (using the examples of individual tangible and intangible assets listed on the Organizational Total Asset Account spreadsheet) that would be of greatest importance to each of the six types of firms from what you provided in your response to the previous Questionnaire # 2 EX.

Special Note: You will find *individual* types of assets listed under each asset category on the proposed *Organizational Total Asset Account* spreadsheet. If you are satisfied with your previous response (from Questionnaire 2 EX) when compared with the composite scores and feedback, you may indicate "Same Response as # 2 EX" on the form, Part 3B.

Based on your overall asset category scoring, what individual assets may be important to the following types of firms? (Please select individual assets from those listed under the overall asset categories on the *Organizational Total Asset Account* spreadsheet)

	400 Person Engineering Firm	4,000 Person EPC Firm	20 Person A/E Firm	200 Person Road Construction Firm	20 Person Light Commercial Building Firm	2,000 Person "Green" Design-Build Firm
Individual Asset "A"						
Individual Asset "B"						

Part 3C – Now re-score the firm's emphasis on asset categories based on what would be accumulated and deployed to *maximize profit for the next quarter*.

Special Note: When viewing the composite scores from Questionnaire 2 EX, you may want to leave your scoring unchanged; therefore, please indicate "Same as Response to Questionnaire 2 EX" in Part 3C of the form below.

Instructions: Place a 1, 2, 3, 4 or 5 in each of the cells below each type of firm (assume a typical firm of each type) indicating 1 = low reliance, 3 = medium reliance, and 5 = high reliance on these categories of assets for profit maximization in the next quarter. *Please use the entire range for your answers – for example, a sitework construction firm that uses mostly unskilled labor may score low (1) for reliance on competence assets and high (5) for reliance on physical produced assets; and conversely, a small structural engineering firm may score low (1) for reliance on physical produced assets, but high (5) for reliance on competence assets.*

YOUR JUDGMENT IS SOUGHT REGARDING: WHAT IS THE RELIANCE OF THE EXAMPLE FIRMS UPON SPECIFIC ASSET CATEGORIES FOR PROFIT MAXIMIZATION DURING THE NEXT QUARTER. (e.g., *what is the relative emphasis on assets that should be accumulated and deployed by a typical firm of this type to maximize short-term profits*).

S. Engineering Firm (400 employees) Specializing in Infrastructure Projects.
(On what asset groups would this typical 400 person engineering firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

T. EPC Firm (4,000 employees) Specializing in Industrial Projects
(On what asset groups would this typical 4,000 person engineering firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

U. A/E Firm (20 employees) Specializing in Institutional Buildings
(On what asset groups would this typical 20 person architect/engineer firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

V. Construction Firm (200 employees) Specializing in Road Construction and Paving Contracts
(On what asset groups would this typical 200 person construction firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organization*	*Competence*	*Motivation*

W. Construction Firm (20 employees) Specializing in Light Commercial Building Construction
(On what asset groups would this typical 20 person construction firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrab*	*Organization*	*Competence*	*Motivation*

X. Design-Build Firm (2,000 employees) Specializing in "Green and Sustainable" Commercial and Institutional Facilities

(On what asset groups would this typical 2,000 person Design-Build firm rely for profit maximization in the next quarter?)

Value Chain, Value Shop or Value Network	*Physical Natural*	*Physical Produced*	*Financial*	*Legal or Registrable*	*Organizational*	*Competence*	*Motivation*

Thank you for your participation!

Please e-mail your filled-out questionnaire form to [e-mail address] on or before July XX, XXXX. If you have any questions about the survey questionnaire or other issues related to this research project, please call me directly at XXX-XXX-XXXX.

Table 52 Comparison of Sample Firms by Different Business Goals

Analysis 1: Characterization of hypothetical firms by different goals

Firm A and G Engieering Firm, 400 employees, Infrastructure projects

Mean values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	1.14	1.86	3.19	3.62	4.24	4.86	4.29
Profit maximization	1.05	1.90	3.43	3.33	3.90	4.29	4.10

Median values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	1.00	2.00	3.00	4.00	4.00	5.00	4.00
Profit maximization	1.00	2.00	3.00	3.00	4.00	5.00	4.00

Firm B and H EPC firm, 4000 employees, Industrial projects

Mean values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	1.76	2.33	4.24	3.62	4.71	4.86	4.05
Profit maximization	1.48	2.29	3.76	3.52	4.05	4.00	4.10

Median values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	2.00	2.00	4.00	4.00	5.00	5.00	4.00
Profit maximization	1.00	2.00	4.00	3.00	4.00	4.00	4.00

Firm C and I A/E firm, 20 employees, Institutional Buildings project

Mean values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	1.05	1.71	3.29	3.29	3.76	4.95	4.43
Profit maximization	1.05	1.71	3.14	3.33	3.67	4.19	4.10

Median values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	1.00	2.00	3.00	3.00	4.00	5.00	5.00
Profit maximization	1.00	1.00	3.00	3.00	3.00	5.00	4.00

Firm D and J Construction firm, 200 employees, Road Construction projects

Mean values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	2.29	4.00	4.14	2.67	3.38	3.52	3.33
Profit maximization	2.05	3.76	4.00	2.95	3.67	3.52	3.57

Median values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	2.00	4.00	4.00	3.00	3.00	3.00	3.00
Profit maximization	1.00	4.00	4.00	3.00	3.00	3.00	4.00

Firm E and K Construction firm, 20 employees, Light commercial projects

Mean values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	1.19	3.00	3.95	2.38	3.29	4.19	3.95
Profit maximization	1.48	3.43	3.76	3.00	3.33	4.10	3.90

Median values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	1.00	3.00	4.00	2.00	3.00	4.00	4.00
Profit maximization	1.00	4.00	4.00	3.00	3.00	5.00	4.00

Firm F and L Design-build firm, 2000 employees, "Green" sustainable projects

Mean values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	2.52	3.05	4.29	3.24	4.57	4.90	4.43
Profit maximization	2.14	3.10	3.81	3.14	3.86	4.48	4.05

Median values

Goal	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	3.00	3.00	4.00	3.00	5.00	5.00	4.00
Profit maximization	2.00	3.00	4.00	3.00	4.00	5.00	4.00

Table 53 Characterization of Asset Emphases by Different Professionals

Analysis 3: Characterization of hypothetical firms by different professionals

Firm A and G Engieering Firm, 400 employees, Infrastructure projects

Mean values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.17	1.67	3.50	3.17	4.17	5.00	4.17
	Architects	1.00	1.67	2.67	3.67	4.00	4.67	4.33
	Constructors	1.50	1.75	3.00	4.00	4.25	4.50	4.50
	Design-Builders	1.00	2.00	3.00	4.00	4.25	5.00	4.00
	Owners	1.00	2.25	3.50	3.50	4.50	5.00	4.50
Profit maximization	Engineers	1.00	1.50	3.50	3.50	3.67	4.83	3.83
	Architects	1.00	1.00	3.67	2.67	3.33	4.00	4.33
	Constructors	1.25	2.00	3.75	3.75	4.25	3.50	4.00
	Design-Builders	1.00	2.50	3.00	4.00	4.25	4.25	3.75
	Owners	1.00	2.50	3.25	2.50	4.00	4.50	4.75

Median values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.00	1.50	3.50	3.00	4.00	5.00	4.00
	Architects	1.00	2.00	3.00	4.00	4.00	5.00	4.00
	Constructors	1.50	1.50	3.00	4.00	4.00	5.00	5.00
	Design-Builders	1.00	2.00	3.00	4.00	4.00	5.00	4.00
	Owners	1.00	2.50	3.00	3.50	4.50	5.00	5.00
Profit maximization	Engineers	1.00	1.50	3.00	3.00	3.00	5.00	4.50
	Architects	1.00	1.00	5.00	3.00	4.00	5.00	4.00
	Constructors	1.00	1.50	4.00	4.00	4.50	4.00	4.50
	Design-Builders	1.00	2.00	3.00	4.00	4.50	4.00	4.00
	Owners	1.00	2.50	3.50	3.00	5.00	5.00	5.00

Firm B and H EPC firm, 4000 employees, Industrial projects

Mean values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.83	2.33	4.33	3.33	4.50	4.83	4.00
	Architects	1.33	2.00	4.00	3.67	4.67	5.00	4.33
	Constructors	2.50	2.50	4.25	4.00	5.00	4.50	4.75
	Design-Builders	1.50	2.00	4.00	4.00	5.00	5.00	3.75
	Owners	1.50	2.75	4.50	3.25	4.50	5.00	3.50
Profit maximization	Engineers	1.50	2.50	4.17	3.50	4.00	4.17	4.00
	Architects	1.33	1.67	3.33	3.67	3.67	3.67	3.67
	Constructors	2.25	1.50	3.50	4.25	4.00	3.50	4.50
	Design-Builders	1.25	2.75	3.50	3.75	4.50	4.00	3.50
	Owners	1.00	2.75	4.00	2.50	4.00	4.50	4.75

Median

Median values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	2.00	2.00	4.50	3.00	5.00	5.00	4.00
	Architects	1.00	2.00	4.00	4.00	5.00	5.00	4.00
	Constructors	2.00	2.00	4.50	4.00	5.00	4.50	5.00
	Design-Builders	1.50	2.00	4.00	4.00	5.00	5.00	4.00
	Owners	1.00	3.00	5.00	3.00	5.00	5.00	3.50
Profit maximization	Engineers	1.00	2.50	4.50	3.50	4.00	4.50	5.00
	Architects	1.00	1.00	4.00	3.00	4.00	4.00	4.00
	Constructors	1.50	1.50	3.50	5.00	4.00	4.00	4.50
	Design-Builders	1.00	2.00	4.00	4.00	4.50	4.00	3.50
	Owners	1.00	3.00	5.00	3.00	5.00	5.00	5.00

Firm C and I A/E firm, 20 employees, Institutional Buildings project

Mean values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.00	1.67	3.50	3.17	3.83	5.00	4.33
	Architects	1.00	1.33	2.67	3.00	3.33	5.00	4.67
	Constructors	1.25	1.75	3.25	3.75	3.75	4.75	4.00
	Design-Builders	1.00	1.75	3.25	3.25	4.00	5.00	4.50
	Owners	1.00	2.00	3.50	3.25	3.75	5.00	4.75
Profit maximization	Engineers	1.00	1.00	3.50	3.50	3.50	4.50	4.00
	Architects	1.00	1.00	2.67	3.67	3.33	4.00	3.67
	Constructors	1.25	2.25	3.00	3.75	3.00	3.75	4.00
	Design-Builders	1.00	2.25	3.25	3.25	4.25	4.00	4.00
	Owners	1.00	2.25	3.00	2.50	4.25	4.50	4.75

Median values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.00	1.50	3.00	3.00	4.00	5.00	4.50
	Architects	1.00	1.00	3.00	3.00	3.00	5.00	5.00
	Constructors	1.00	1.50	3.00	4.00	3.50	5.00	4.00
	Design-Builders	1.00	2.00	3.00	3.00	4.00	5.00	4.50
	Owners	1.00	2.00	3.00	3.00	3.50	5.00	5.00
Profit maximization	Engineers	1.00	1.00	3.00	3.00	3.00	5.00	4.50
	Architects	1.00	1.00	3.00	4.00	3.00	5.00	4.00
	Constructors	1.00	1.50	2.50	4.00	2.50	4.50	4.00
	Design-Builders	1.00	1.50	3.50	3.00	4.50	4.50	4.00
	Owners	1.00	2.00	3.00	3.00	4.50	5.00	5.00

Firm D and J Construction firm, 200 employees, Road Construction projects

Mean values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.83	3.33	4.00	2.67	3.50	4.17	3.67
	Architects	2.67	4.00	4.33	2.67	2.67	3.00	3.00
	Constructors	3.00	4.00	4.25	3.00	3.50	3.50	3.50
	Design-Builders	1.75	4.25	3.75	3.00	3.50	3.25	3.00
	Owners	2.50	4.75	4.50	2.00	3.50	3.25	3.25
Profit maximization	Engineers	1.83	3.50	4.33	3.67	3.83	4.00	3.17
	Architects	2.00	3.33	4.33	3.67	3.67	2.67	2.67
	Constructors	2.75	3.00	3.75	2.75	3.50	3.25	4.00
	Design-Builders	1.25	4.00	3.50	2.75	4.25	4.00	3.75
	Owners	2.50	5.00	4.00	1.75	3.00	3.25	4.25

Median values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.50	3.50	4.00	2.50	3.00	4.50	3.50
	Architects	3.00	4.00	4.00	2.00	3.00	3.00	3.00
	Constructors	3.50	4.00	4.50	3.00	3.00	3.50	3.50
	Design-Builders	2.00	4.00	4.00	3.00	3.50	3.00	3.00
	Owners	2.00	5.00	5.00	2.00	3.00	3.00	3.00
Profit maximization	Engineers	1.00	4.00	5.00	3.50	3.50	4.00	3.00
	Architects	2.00	3.00	4.00	4.00	4.00	3.00	3.00
	Constructors	3.00	3.00	4.00	2.50	3.00	3.50	4.00
	Design-Builders	1.00	4.50	4.00	2.50	4.50	4.00	4.00
	Owners	2.00	5.00	5.00	1.50	3.00	3.50	4.50

Firm E and K Construction firm, 20 employees, Light commercial projects

Mean values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.33	2.83	4.17	2.50	2.83	4.83	4.00
	Architects	1.00	2.33	3.00	2.00	3.33	3.33	4.33
	Constructors	1.25	2.50	4.00	2.75	3.25	4.00	3.75
	Design-Builders	1.25	3.50	3.50	2.50	3.75	3.75	3.50
	Owners	1.00	3.75	4.75	2.00	3.50	4.50	4.25
Profit maximization	Engineers	1.67	3.17	4.00	3.67	3.17	4.67	3.50
	Architects	1.33	2.33	4.33	3.67	3.33	3.67	3.67
	Constructors	1.75	2.75	3.50	3.25	3.00	3.25	4.00
	Design-Builders	1.50	3.75	3.25	2.50	4.25	4.50	4.00
	Owners	1.00	5.00	3.75	1.75	3.00	4.00	4.50

Median values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	1.00	3.00	4.50	2.50	3.00	5.00	4.00
	Architects	1.00	3.00	3.00	2.00	3.00	3.00	4.00

	Constructors	1.00	2.50	4.00	3.00	3.00	4.00	4.00
	Design-Builders	1.00	3.50	3.50	2.50	3.50	3.50	3.50
	Owners	1.00	4.00	5.00	2.00	3.00	5.00	4.50
Profit maximization	Engineers	1.00	3.00	4.00	4.00	3.00	5.00	3.50
	Architects	1.00	2.00	4.00	4.00	4.00	4.00	4.00
	Constructors	1.50	2.50	3.50	3.00	2.50	3.50	4.00
	Design-Builders	1.50	4.00	3.50	2.50	4.50	4.50	4.00
	Owners	1.00	5.00	4.50	1.50	3.00	5.00	5.00

Firm F and L Design-build firm, 2000 employees, "Green" sustainable projects

Mean values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	2.83	2.67	4.50	3.33	4.67	4.83	4.00
	Architects	2.00	2.67	4.00	3.00	5.00	5.00	4.67
	Constructors	3.00	3.25	4.50	3.50	4.50	5.00	5.00
	Design-Builders	2.25	3.00	4.00	3.25	5.00	5.00	4.25
	Owners	2.25	3.75	4.25	3.00	3.75	4.75	4.50
Profit maximization	Engineers	2.33	3.17	4.00	3.50	3.83	4.50	4.00
	Architects	2.33	2.00	4.00	3.67	3.67	4.00	4.00
	Constructors	1.75	3.00	3.75	3.75	3.75	4.25	3.75
	Design-Builders	2.75	3.50	3.50	2.75	4.75	4.50	3.75
	Owners	1.50	3.50	3.75	2.00	3.25	5.00	4.75

Median values

Goal	Profession	Physical Natural	Physical Produced	Financial	Legal or Registrable	Organizational	Competence	Motivation
Continuity and longevity	Engineers	3.00	3.00	4.50	3.00	5.00	5.00	4.00
	Architects	2.00	3.00	4.00	3.00	5.00	5.00	5.00
	Constructors	3.00	3.00	4.50	3.50	4.50	5.00	5.00
	Design-Builders	2.50	3.00	4.00	3.00	5.00	5.00	4.00
	Owners	1.50	4.00	4.50	3.00	3.50	5.00	4.50
Profit maximization	Engineers	2.50	3.00	4.00	3.00	3.50	5.00	4.00
	Architects	3.00	2.00	4.00	4.00	4.00	5.00	4.00
	Constructors	1.50	3.00	4.00	3.50	4.00	4.00	4.50
	Design-Builders	2.00	3.50	4.00	3.00	5.00	4.50	4.00
	Owners	1.00	3.50	4.50	2.00	3.50	5.00	5.00

Table 54 Intangible Assets Accounting Sheet – Organizational

Table 54: INTANGIBLE ASSETS ACCOUNTING SHEET – *ORGANIZATIONAL*

Intangible Asset Group or Subgroup	*Tertiary Rating of Asset within Firm: Fully Present, Partially Present or Not Present*	*"Enabling" Asset or "Effort-Based" Asset?*	*Average Projected Service Life of Asset Group or Subgroup*	*Aggregate Accumulated Asset Group or Subgroup Value in Person Years/Hrs*	*Aggregate Remaining Useful Life of Asset Group or Subgroup*	*Amount of Asset Group or Subgroup Deployed During the Year*	*Efficiency of Asset Use – Amt Deployed Divided By Amt Remaining*	*Effectiveness of Asset Use – Met Strategic Goals? Met Market Challenges?*	*Estimated Strategic Value of Asset Group or Subgroup Next 2 Yrs (%+ or -)*	*Estimated Sustainable Value of Asset Group or Subgroup Next 7 Yrs (%+or-)*	*Management Action Anticipated Related to Asset Group or Subgroup –Add to Stock, Status Quo, Redeploy, Reduce Stock, Liquidate, or Other (Explain)*
Organizational Processes:											
▪ Formal Processes											
▪ Informal Routines											
▪ Research & Development											
▪ Execution of Bus Strat											
Organizational Structure:											
▪ . Legal Structure											
▪ Management Structure											
▪ Projcts/Cntrcts Approach											
▪ Going Concern Value											
Technological:											
▪ Adoption of IT Hardware											
▪ Adoption of Software											
▪ Other New Technologies											
▪ Use of Web/Virtul Ntwks											
External and Relational:											
▪ Brand and Reputation											
▪ Customers/Users											
▪ Outreach Measures											
▪ Repeat Customers											
▪ Other Goodwill											

Table 55 Intangible Assets Accounting Sheet – Competence

Table 55: INTANGIBLE ASSETS ACCOUNTING SHEET – *COMPETENCE*

Intangible Asset Group or Subgroup	*Tertiary Rating of Asset within Firm: Fully Present, Partially Present or Not Present*	*"Enabling" Asset or "Effort-Based" Asset?*	*Average Projected Service Life of Asset Group or Subgroup*	*Aggregate Accumulated Asset Group or Subgroup Value in Person Years/Hrs*	*Aggregate Remaining Useful Life of Asset Group or Subgroup*	*Amount of Asset Group or Subgroup Deployed During the Year*	*Efficiency of Asset Use – Amt Deployed Divided By Amt Remaining*	*Effectiveness of Asset Use – Met Strategic Goals? Met Market Challenges?*	*Estimated Strategic Value of Asset Group or Subgroup Next 2 Yrs (%+ or -)*	*Estimated Sustainable Value of Asset Group or Subgroup Next 7 Yrs (%+or-)*	*Management Action Anticipated Related to Asset Group or Subgroup – Add to Stock, Status Quo, Redeploy, Reduce Stock, Liquidate, or Other (Explain)*
Human Assets:											
• Education											
• Experienc & Tacit Know											
• Prof Skills/Proficiencies											
• Use of Technologies											
• Special Talents											
• Retention/Promotion											
Continuing Development:											
• Training											
• Team Experience											
• Interaction w/ Customers											
• Knowl Acquis & Dissem											
Embedded Know-How/Procedur:											
• Sum of Indiv Know-How											
• Collective Know-How											
• Grp Routines & Proced											
• Deep Intracts/Mentorship											
Culture and Commitment:											
• Attitudes, Values & Trust											
• Esprit de Corps/Loyalty											
• Sustainable Practices											

Table 56 Intangible Assets Accounting Sheet – Motivation

Table 56: INTANGIBLE ASSETS ACCOUNTING SHEET – *MOTIVATION*

Intangible Asset Group or Subgroup	*Tertiary Rating of Asset within Firm: Fully Present, Partially Present or Not Present*	*"Enabling" Asset or "Effort-Based" Asset?*	*Average Projected Service Life of Asset Group or Subgroup*	*Aggregate Accumulated Asset Group or Subgroup Value in Person Years/Hrs*	*Aggregate Remaining Useful Life of Asset Group or Subgroup*	*Amount of Asset Group or Subgroup Deployed During the Year*	*Efficiency of Asset Use – Amt Deployed Divided By Amt Remaining*	*Effectiveness of Asset Use – Met Strategic Goals? Met Market Challenges?*	*Estimated Strategic Value of Asset Group or Subgroup Next 2 Yrs (%+ or -)*	*Estimated Sustainable Value of Asset Group or Subgroup Next 7 Yrs (%+or-)*	*Management Action Anticipated Related to Asset Group or Subgroup – Add to Stock, Status Quo, Redeploy, Reduce Stock, Liquidate, or Other (Explain)*
Leadership:											
▪ Leadership Style											
▪ Leadership Effectiveness											
▪ Entrepreneurial Drive											
▪ Integrity											
▪ Stratgy Commun/Execut											
Innovation and Creativity:											
▪ Degree of Innov Culture											
▪ Rewards for Creativity											
▪ Challgng Projs/Designs											
▪ Aesthet/Functn Awards											
Purpose, Vision and Strategy:											
▪ Firm Value Proposition											
▪ Articulated Vision											
▪ Strategc Plan & Planning											
▪ Plan Diffus/Acceptanc											
▪ Forward Reach of Plan											
▪ Fit of Prod/Svc to Mkt											

Table 57 Organizational Total Asset Accounting Spreadsheet

Table 57: ORGANIZATIONAL TOTAL ASSET ACCOUNTING Spreadsheet* – Toward a Holistic View of an Organization's Resource Base

Corporeal Assets *Volitional Assets*

PHYSICAL NATURAL ASSETS	*PHYSICAL PRODUCED ASSETS*	*FINANCIAL ASSETS*	*LEGAL or REGISTRABLE ASSETS*	*ORGANIZATIONAL ASSETS*	*COMPETENCE ASSETS*	*MOTIVATION ASSETS*
Non-Renewables:	Fixed:	Cash and Cash Equivalents:	Intellectual Property:	Organizational Processes:	Human Assets:	Leadership:
▪ Land*	▪ Plant & Machinery	▪ Currency	▪ Patents	▪ Formal Processes	▪ Education	▪ Leadership Style
▪ Minerals	▪ Buildings	▪ Deposit Accounts	▪ Trademarks	▪ Informal Routines	▪ Experienc & Tacit Know	▪ Leadership Effectiveness
▪ Metals	▪ Tools	▪ Negotiables	▪ Service Marks	▪ Research & Development	▪ Prof Skills/Proficiencies	▪ Entrepreneurial Drive
▪ Fossil Fuels	▪ Investment Property		▪ Websites/Domain Names	▪ Execution of Bus Strat	▪ Use of Technologies	▪ Integrity
▪ Other Nonrenewable	▪ Electronic Hrdwr/Systms	Short-Term Investments	▪ Web Networks		▪ Special Talents	▪ Stratgy Commun/Execut
	▪ Other Phys Infrastructure		▪ Copyrts/Sealed Designs	Organizational Structure:	▪ Retention/Promotion	
Renewables:		Receivables		▪ Legal Structure		Innovation and Creativity:
▪ Solar	Mobile:		Agreements, Contracts, Projects:	▪ Management Structure	Continuing Development:	▪ Degree of Innov Culture
▪ Wind	▪ Trucks/Rolling Stock	Inventory	▪ Franchises	▪ Projcts/Cntrcts Approach	▪ Training	▪ Rewards for Creativity
▪ Air**	▪ Bulk Containers		▪ Licenses	▪ Going Concern Value	▪ Team Experience	▪ Challgng Projs/Designs
▪ Water**	▪ Produced Materials	Pre-Paid Expenses	▪ Contracts		▪ Interaction w/ Customers	▪ Aesthet/Functn Awards
▪ Soil**	▪ Equipment		▪ Projects	Technological:	▪ Knowl Acquis & Dissem	
▪ Biological**	▪ Furniture & Accessories	Long-Term Financial Investment:	▪ Permits	▪ Adoption of IT Hardware		Purpose, Vision and Strategy:
– Timber/Crops/Lvstck	▪ Business/Personl Proprty	▪ Bonds		▪ Adoption of Software	Embedded Know-How/Procedur:	▪ Firm Value Proposition
– Other Plants/Animals	▪ Original Works of Art	▪ Stocks	Other Explicit and Recorded:	▪ Other New Technologies	▪ Sum of Indiv Know-How	▪ Articulated Vision
– Other Biological		▪ Special Funds	▪ Internal Trade Secrets	▪ Use of Web/Virtul Ntwks	▪ Collective Know-How	▪ Strategc Plan & Planning
		▪ Some Forms of Insurance	▪ Databases		▪ Grp Routines & Proced	▪ Plan Diffus/Acceptanc
			▪ Recorded Explicit Knowl	External and Relational:	▪ Deep Intracts/Mentorship	▪ Forward Reach of Plan
				▪ Brand and Reputation		▪ Fit of Prod/Svc to Mkt
				▪ Customers/Users	Culture and Commitment:	
* partially renewable				▪ Outreach Measures	▪ Attitudes, Values & Trust	
** partially non-renewable				▪ Repeat Customers	▪ Esprit de Corps/Loyalty	
				▪ Other Goodwill	▪ Sustainable Practices	
					▪ Adaptiveness	

* Organizational Total Asset Accounting includes all assets, both on and off the traditional financial balance sheet, and whether owned, controlled, partially controlled or influenced (including financially, socially and environmentally) by the firm (or other business/government entity), and either held for value or used in the production process. — J. L. Beard, October 2009

Table 58 Compilation of Individual Assets Chosen by Expert Panel

	400 Person Engineering Firm	**4,000 Person EPC Firm**	**20 Person A/E Firm**	**200 Person Road Const Firm**	**20 Person Light Commercial Bldg Firm**	**2,000 Person "Green" Design-Build Firm**
Individual Assets with Multiple Votes (from Survey # 3 EXP – *only assets receiving at least two "votes" by the expert panel are listed*)	(11) Human Assets (6) Prof Skills/Profic (3) Technolog (4) Projects & Contracts (5) Embed. Know-How (2) Repeat Customers (2) Exper & Tacit Knowl (2) Purpose, Vision, Strat	(9) Projects & Contracts (5) Prof Skills/Profic (2) Adoption of Technol (2) Embed Know-How (2) Financ Investments (2) Organiz Structure (2) Organiz Processes	(9) Human Assets (8) Prof Skills/Profic (6) Innovat & Creativity (4) Brand & Reputation (2) Leadrshp Effectivness (2) Collectiv Know-How (2) Projs & Contracts	(15) Cash & Equity (7) Mobile Equipmnt (5) Insurance & Bonding (4) Machinry & Tools (2) Projects & Contracts (2) Exper & Tacit Knowl	(7) Experien & Tacit Kno (6) Projects & Contracts (6) Cash & Equity (3) Human Assets (2) Informal Routines (2) Leadrshp Effectivenes (2) Receivables	(8) Human Assets (7) Innovat & Creativity (5) Use of Technolog (3) Purpose, Vision, Strat (2) Brand & Reputation (2) Pro Skills/Profic (2) Projects & Contracts
Categories Represented by Choices of Individual Assets (Category and Votes per Category)	Competence: 21 assets Organization: 5 assets Legal/Regist: 3 assets Motivation: 2 assets	Legal & Regis: 9 assets Competence: 7 assets Organization: 6 assets Financial: 2 assets	Competence: 19 assets Motivation: 14 assets Organization: 4 assets Legal/Regist: 2 assets	Financial: 20 assets Phys Produc: 11 assets Legal/Regist: 2 assets Competence: 2 assets	Competence: 10 assets Financial: 8 assets Legal/Regist: 6 assets Motivation: 2 assets Organization: 2 assets	Motivation: 10 assets Competence: 10 assets Organization: 7 assets Legal/Regist: 2 assets

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